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ELEMENTARY TREATISE

ON

THE FINISHING

OF WHITE, DYED,

AND PRINTED COTTON GOODS

BY

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TRANSLATED FROM THE LATEST FRENCH EDITION.

AWARDED A PRIZE
BY THE SOCIÉTÉ INDUSTRIELLE OF MULHOUSE,
THE SOCIÉTÉ D'ENCOURAGEMENT POUR L'INDUSTRIE
NATIONALE OF PARIS,
AND THE CONCOURS INTERNATIONAL OF BRUSSELS.

WITH 165 ENGRAVINGS, 10 TABLES AND 116 PATTERNS.

MANCHESTER.
GEO. THOMAS & Co.
1889.

PREFACE TO FRENCH EDITION.

One of the most important branches of the textile industry, viz. Finishing, has not hitherto been the subject of any special treatise, at least in France. This branch is wrongly considered as an accessory part and many of the technical works treat it only very superficially.

In the first Chapters, the substances employed in Finishing such as Thickenings, (Starch mixtures), Softenings, Colors, Chemicals etc. are treated and also the methods of using them.

Then the machines employed, a matter of great importance, are exhaustively dealt with.

Chloring and Blueing are also included in the sphere of our observations as these operations equally belong to the Finishing branch.

Further the important question in the cotton industry of mould formation and mildew, and its serious consequences, could not silently be passed over.

Finally the work contains a series of Finishing formulae or recipes in which the various operations in Finishing are practically described in detail. Numerous patterns of unfinished and finished fabrics show at a glance the remarkable results of the Finishing processes.

The author avails himself of this opportunity to express his obligation to those Machine Makers who have kindly placed »electros« at his disposal, as well as to those colleagues who have assisted him with patterns and valuable information.

THE AUTHOR.

EDITORS' PREFACE.

The great success of the »Traité des apprêts« which ran completely through one edition within 12 months, and also of the German edition, induced us to translate and publish in English, the present carefully revised work.

Although the English technical publications give very often valuable information, still the new and interesting facts set forth in the present volume, and which we do not think have ever been published before, gave us reason to suppose that the work would prove highly interesting and of service to those engaged in the branches dealt with, and who might not be conversant with the French language or continental methods of finishing.

We wish our readers to bear in mind that the work is a translation, and although in some instances we have anglicised a few phrases, we have endeavoured to keep as much as possible

to the original, and in conclusion trust that the work may meet with the same hearty reception and generous support as has been accorded to the French and German editions.

MANCHESTER 1889.

Geo: Thomas & Co.

ELEMENTARY TREATISE
ON
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AND PRINTED COTTON GOODS.

FIRST PART.
FINISHING IN GENERAL.

CHAPTER I.
DEFINITION OF FINISHING—DIFFERENT STYLES OF FINISHES.

The generic name of *finishing* is given to the preparatory and finishing operations, which yarns and materials of all sorts undergo, according to their nature, their manufacture and the use to which they are destined.

Finishing may be considered as one of the branches of the extensive manufacture of textile fabrics. In some cases it becomes the basis of a distinct industry, with its special establishments works, fitted up with special machinery, for ultimately finishing the materials of the manufacturer of cloth or printed calico.

The word »**apprêt**«, which is the French for finishing, comes from the Latin word *adparare*,

and has only in our days acquired the signification which is given to it. It was primitively the simple final operation, employed to render the goods *merchantable*. — What the English term *finishing*, the Germans, Italians and French designate by the word, *appretiren*, *apparatura*, *apprêt*, comprises all operations whether preparatory or final.

We will not search out the meaning that may have been given to this word by authors writing on finishing. There are so few works, especially in French, which treat of this subject and particularly of the finishing of cotton goods — *the only kind which we shall exclusively and attentively examine* — that the choice is limited. Without entering into an examination of the various definitions, we shall confine our attention to the one which appears to us to be the most logical, exact and appropriate. It is given by *Alcan* in his *Traité du travail de la laine*, Volume II.

» To finish any sort of material, he says, is » to develop and make evident in the most ad- » vantageous manner the nature of the substance » or substances of which it is composed, to give » to the stuff the most favorable appearance and » the qualities most suitable for the use to which » it is destined.

» The series of operations which constitute » finishing ought consequently to be combined, on » the one hand, taking into account the special nature

» of the fibres of the raw material, and on the » other hand with a view to the desired appearance » of the product. These considerations show, first » of all, that there are, for the innumerable articles » furnishes by the fibres, a certain number of » finishes, which are natural to them, according to » their origin; and a certain number of others which » differ from their nature according to their ultimate » purposes.

» Apprêter une étoffe quelconque, dit-il, c'est » développer et mettre en évidence de la façon la » plus avantageuse les caractères de la substance » ou des substances qui la composent, pour donner » au tissu l'apparence la plus favorable et les qualités » les mieux appropriées à l'usage auquel on les » destine.

» La série des opérations, qui constituent les apprêts » doit par conséquent être combinée, d'une part, en » raison de la nature intime des fibres de la matière » première et de l'autre, en vue de l'aspect recherché » dans le produit. Ces considérations indiquent tout » d'abord, qu'il y a pour les innombrables articles » fournis par les fibres un certain nombre de moyens » qui leur sont communs, comme leur origine et un » certain nombre d'autres, qui diffèrent, suivant leur » constitution définitive. —

It is clearly understood, and we insist on this point, that to a buyer the finish ought to show off to advantage the *real* quality of the goods: —

finishing ought not to be a falsification of the material, that is to say, it ought not to be an imitation of a quality superior to that of the material before finishing.

This operation ought only to be a sort of dressing, intended to render the goods presentable, but the effect, produced by this dressing, should not be detrimental to the tissue to which it is applied.

At the present day there is a tendency to dissemble the real quality of materials by »*weighted*« sizing, that is, they incorporate with the starch considerable quantities of substances to increase its weight, so as to offer to the consumer a tissue, appearing of a quality much superior to what it really is. We consider this way of working, which is contrary to the most elementary principles of probity, to be, whatever they may say, against the very interests of those who expect to profit by it. If they reflected on the effects, arising from over-weighted sizing they could not remain ignorant of the fact that the producer himself is working indubitably to his own prejudice, confidence is lost, an article is suddenly set aside without any apparent reason, and the manufacturer attributes this change to every other cause except the right one.

If Alsace has maintained an incontestable superiority for its printed, as well as its white goods, a great part of its continued success is owing to the careful finishing of its goods, which

are seldom "weighted" and when so in very small proportions, not as it has been customary with certain English goods, prepared for export, and which contain as much as 80 and even 100% of substances foreign to the fibre. Certain English authors (*W. Thomson* — "The Sizing of Cotton" goods, Manchester 1877 the 12th and following pages) do not hesitate to affirm that the heavily-sizing of goods is a condition insisted on by the buyer. — Now we know very well, that the buyer cannot always obtain from the manufacturer the article he desires and exactly as he desires it, but who does not know that the manufacturer in the first place or the intermediary merchant the *Trade-finisher* imposes in most cases his goods on the consumer, as is the case in the Oriental countries, India, China, etc. This system has also serious disadvantages of which we will speak in the chapter relating to mildew.

Another remarkable point is that the large exporters — the English manufacturer especially — pretend that the Oriental market demands heavily sized or »filled« goods.

This seems to us a contradiction, for it is a remarkable fact that these people, who were our masters in the art of weaving and dyeing, have never heavily sized their stuffs, and do not do so at the present time.

Rice was and is still the only substance used by them for starching and finishing. (1).

We ought also to add, that public opinion in England was far from being favorable to this system and several authors condemn it. *(Dreyfus* and *Holland*. "Sizing and Mildew in Cotton Goods" 1879, 98 and the following pages).

Finishing operations may be classed according to the results required.

We shall firstly enumerate succinctly the different methods of finishing all kinds of goods; secondly we shall study, separately, the substances employed, the machines used, the different ways of blueing, the ordinary processes of finishing all woven, white, dyed and printed cotton fibres; lastly the accidents arising from mildew and the means of preventing it.

We admit seven classes of finishes in which may be included all the numerous kinds produced at the present day. —

First class. The operations, which are intended to render the surface of the materials clear,

(1) Ancient process of the Indians of dressing their linen, which is still in use. Extract from the report of Messrs. de Beaulieu & Dufay of Pondicherry (Chapter I on the method of the Indians). DOLFUS AUSSET, *Matériaux pour la coloration des étoffes.*

"The linen is steeped in *rice water* varying in strength according to the body to be given to the linen; when it is dry it is spread upon a well polished table, rubbed with a shell and then put under press."

smooth and free from down, consist in the *singeing*, and shearing.

This kind of finish is applied principally to woollen goods and is not considered as a finishing operation in the manipulation of cotton materials.

It is the same with the operation of *felting* which constitutes a finishing for cloth, but not for cotton. — It is the operation by which the fibres of woollen materials are tightened (1), by subjecting them to the action of special machines called »*fulling-stocks*«.

The name ot *treatment* (*traitement de la pièce* french) of tissues is given to these operations.

Second class. The operations which render the tissue supple, fluffy and woolly, they are done by *Raising Machines*, *Napping Machines*, *Brushing or so called Finishing Machines etc.*

Third class. The finish, destined to soften and fill the materials or to loosen the threads, is obtained by *steaming*, *shrinking*, *moistening*, *damping*, *spunging or dipping in hygroscopic substances*, after which the materials are exposed in a damp place.

Fourth class. The finishing which acts upon the material to enlarge or lengthen it, whether previously stiffened or not, as produced by the *fixed and continuous Stenters*, *Improved Stretching Machines and the socalled "St. Quentin frames"* (métiers de St. Quentin).

(1) *Tightened,* that is to say the fibres are brought more or less into closer contact.

Fifth class. The finishing by which a material, stiffened or not, previously filled with feculent matter, becomes brilliant, glazed, satined etc., is made by means of *cylinders*, *calenders*, *mangles*, *beetles* etc.

Sixth class. The finishing, destined to strengthen, thicken and give body to the material, is produced by *gumming*, *sizing*, *starching*, in general by being passed through a bath containing a thickening matter, or some substance capable of giving a thick feel and consistence to the material. These are the sorts of finishing more particularly used for cotton materials and which will specially occupy our attention.

Seventh class. The finishing destined to fix designs "*en relief*", or special designs on the material, such as the market demands for materials for fans, for binding, pattern cards, linings etc., and which is obtained by *glazing, embossing, watering* and other special processes.

These different sorts of operations are applied either separately, or are combined according to the result to be obtained. It is impossible and besides superfluous to enumerate the different styles of finish used to-day. There are more than one hundred well-defined kinds, and, notwithstanding this variety, the buyer often requests a slight modification, which thus sometimes produces a new style.

Just as each country has its favorite colour — we are now speaking of printed cottons — red in

Russia, violet in Holland, yellow in Roumania, pink in Lower Austria, blue in Hungary etc., so each country has its particular style of finish. Fashion also greatly influences, and often occasions sudden and considerable changes. Some years ago, nearly all cottons were glazed, to-day the preference is given to dull finishes.

The requirements of each country, of each locality, so to speak, dictate the styles of finish which then receive special names.

The use of drugs is of less importance in finishing from a chemical point of view, than in dyeing and printing. The principal part in finishing falls to machines and especially to manual dexterity.

This is perhaps one of the reasons of the deficiency of treatises relating to this part of textile industry.

From what we have explained, the immense progress realized in the art of finishing can easily be imagined.

If we go back to the end of the last century, we find that the Calico Printers used for all the various kinds of print only two sorts of finishes.

Rhyner's manuscript issued in 1766 and finished 1783 (to be found in the library of the "*Société Industrielle de Mulhouse*") gives the following information on finishing:

Starch for finishing 1776:

	«pots»	℔.	litres	grammes
Water	64	—	96	—
Fine starch	—	20	—	10,000
«*Kid-Glove*» gelatine . .	5	—	7·5	—
White wax	—	$1^1/_2$	—	750

»Kid-glove« gelatine.

	«pots»	℔.	litres	grammes
Water	20	—	30	—
Kid glove clippings . . .	—	$2^1/_2$	—	1250

Boil in twenty pots of water until the water has evaporated to ten pots, then leave it to congeal on cooling.

In the manuscript he describes the method of operation thus:

» To give the finish, a *decoction of starch* is used,
» to which is mixed, a *decoction of isinglass,* blue
» is added so as to give to the white ground
» the bluish tint; which will be subsequently ex-
» plained; after this the material is glazed and
» pressed.

The blue employed was nothing else than sulphate of indigo.

The authors in the beginning of this century have but slightly touched on the question of finishing.

Thillaye, on the »Fabrications des Indiennes Paris 1834«, gives four formulae for finishing and

indicates as substances used: fecula, starch, white soap and white wax. With this preparation he finished nine or ten varieties of tissues.

In his »Traité de l'Impression des Tissus«, *Persoz* indicates summarily the course to be taken for finishing, and we observe he refers to the use of other substances such as: alum, spermaceti, stearic acid, gum and dextrine or British gum. —

A German writer, but little known in France *Kreisig*, "Der Zeugdruck," Berlin 1837) published, before *Persoz*, a treatise in four volumes on the printing of tissues. He already indicates the substances mentioned above and recommends also gum-tragacanth.

The treatment he gives specifies eight well-defined kinds of finish.

It was in 1851, in England, that goods were first-heavily sized or weighted whence the practice spread itself on the continent.

The various finishes in vogue now-a-days are composed of a great number of products, which we shall summarily examine in the following chapter.

CHAPTER II.

SUBSTANCES EMPLOYED IN FINISHING.

The quantity of products of all kinds used in finishing increases daily. We shall enumerate them, and classify them notifying each product and specifying the place or part each of them occupies in the trade.

1. *Thickenings in the proper sense of the word, that is to say, substances serving to stiffen tissues, to thicken them in one word, to set them.*

Corn, wheat, maize, barley, chestnut, rice, acorn, potato or »farina« starches and diverse flours. — Arrowroot, salep, sago, tapioca, linseed. — Gums, gum-tragacanth, dextrine, leiogomme, gelatine, isinglass, hai-thao, lichens, Iceland moss, algae, apparatine, dulcine, albumen, casein.

2. *Emollient softening or hygroscopic substances.*

Glycerine, glucose, fatty-matters, tallow, paraffin, stearine, »parement Freppel«, spermaceti, cocoa-nut oil, soluble oil, olive oil, bees-wax, Japan wax, soda ash, ammonia, dulcine, chloride of calcium, chloride of zinc.

3. *Substances for giving weight and body.*

Gypsum, plaster of Paris, sulphate of lime, chalk, Spanish clay, sulphate of baryta, sulphate of magnesia, sulphate of soda, sulphate of zinc, steatite, talc, china-clay

or kaolin, chloride of magnesia, chloride of barium, carbonate of barium, sulphate of lead, cellulose.

4. Substances used for colouring size.

Ultramarine, blues, pinks, violets, greens, Prussians blues, Indigo blues, Paris blue, soluble Indigo blue, aniline blues of all kinds, cobalt blues, Indigo carmine, ammoniacal cochineal, black, grey and dark mineral matters etc. Ochres of all colours.

5. Antiseptics.

Carbolic cacid, ɹeosote, salicylic acid and salicylates tannic acid, camphor, oxalic acid, arsenious and arsenic acid, sulphate of zinc, chloride of zinc, boracic acid. Borate of soda, alum, sulphate of alumina, chloride of sodium, formic acid, sulfobenzylamide, borhydrine. (See the chapter on Mildew.)

6. Substances used to make fabrics waterproof.

Greasy matters of all natures, resin, paraffin, tannic acid, siccative or drying oils, salts of alumina, alums, carbonate of magnesia.

7. Substances destined to render tissues incombustible.

Boracic acid, borax, phosphate of soda, phosphate of lime, phosphate of ammonia, carbonate of magnesia, tungstate of chrome, alum, sulphate of soda, silicates in general, gypsum, sulphate of zinc, salts of magnesia.

8. Substances used to give a metallic lustre.

Sulphides of lead, silver, tin, antimony, etc. Bronze, silver, copper and gold powders; argentine etc.

1. Thickenings.

Divers starches. Of all the substances used in finishing, starch and its derivatives are those which play the greatest part; whether it be in the state of wheaten or any other cereal starch, it is generally the thickening, most handy, and most often used for stiffening. We shall therefore enter more minutely into the examination of this body, and we shall treat summarily of the other substances which have been largely describet in differend works on chemistry (see *Girardin*, »Chimie élémentaire«. — *Dr. Pennetier*, »Leçons sur les matières premières«. — *Schutzenberger*, »Traité des matières colorantes etc.« and the English authors.)

From a chemical point of view, the expressions starch and fecula are synonymous, but in trade the name of »*starch*« is given to the substance which comes from grains and »*fecula*« when it is taken from other parts of the plant. (*Pennetier*, »Leçons sur les matières premières«. page 1 to 86).

Starch has been known from time immemorial. Pliny speaks of its manufacture in Chio. The first use of starch for sizing dates from about 800 B. C. — Its usage however was not very extensive. Was it forgotten, or did it fall into desuetude on account of the meagre demand of goods suitable for stiffening, we cannot say. —

The use of starch in England dates from the first part of the 16^{th} century, but it was only during the latter part of that century, that it was used for body or under linen. A Dutchwoman named Guilham, the wife of Queen Elizabeth's coachman, won the favour of this sovereign and became the superintendent of the royal laundries. Her reputation extended throughout the kingdom and titled ladies came to take lessons in starching from $M^{rs.}$ Guilham. From this time in the most aristocratic residences, were to be seen tubs and other utensils necessary for the preparation of starch, which are to-day banished to the laundries. Washing, drying, hanging-out and ironing, were performed in the presence of nobles, as are to-day music and other arts. The rage was such that a Flemish professor Madame Dinghen Van der Plassen was brought to London as professor of laundry-work. Her reception can only be compared to that now given to persons of highest rank. She was paid £. 5 a lesson.

For some time blue had been used in starching, but Queen Elizabeth, in her old age, was seized with such an aversion to blued linen, that she forbade the use of it. But as the nobility appeared to pay no attention to this prohibition, she issued an edict, which was read from the pulpit in the church of St. Vuttolp, Aldgate. June 27^{th} 1596.

» Our gracious sovereign forbade, some time
» ago, any man or woman of whatever rank, to

» wear blued linen. Several citizens have dared
» to violate this royal command.

» Therefore it is the grave desire and formal
» order of Her Majesty that it be made known
» to all people of every rank or sex, that whosoewer
» maketh use of blued body linen will incur the
» displeasure of the Queen. — The offender will
» be liable to the penalty of imprisonment, the
» term of which will be decided by Her Majesty.
» Therofore let everyone so act as not to be
» punished. Given at Guildhall.« 23. June 1596.

The use of starch and blue being at the present day universal, prodigious quantities of it are consumed. — It is to be regretted that such large quantities of a produce, the principal ingredient of which is wheat, theoretically and practically the most perfect vegetable aliment, should be so profusely used in industry. (*Thieberge et Romilly*, »De l'amidon de marron d'Inde« 1857.)

The starches, syrups and printing of tissues, alcohols, annually absorb almost 1,500.000 hectol. of cereals and 8,000.000 hectol. of potatoes. There is a family of non-alimentary vegetables, such as the horse chestnut, oak, bryony, water-chestnut, or Cornel from which feculas for industrial purposes, can be obt ained.

On account of the extensive use of feculas, large quantities of flour destined for food is diverted in consequence of which the price of alimentary products is raised. —

Some years ago the Belgian government offered a prize of 10.000 frs. for the discovery of a non-alimentary substance, capable of replacing the feculas in industrial uses. This prize was never awarded.

Starch intended for sizing should be chosen according to the different goods to be treated.

We shall see later on what is the degree of stiffness given by wheaten starch, potato starch and rice starch.

The use of rice starch for sizing is pretty general, but it is especially employed for warps and fine tissues, for finishing handkerchiefs and sateens. Considerable quantities of it are manufactured in England and Belgium.

Starch always appears in the form of granules, varying in shape and size according to the plants from which it is obtained. — Each granule is composed of concentric layers, superposed, of different thicknesses, disposed in meridian sections around a point visible under the microscope, called *hilum* or *umbilicus*. From this symmetrical arrangement, it results that a granule of starch, viewed by means of polarized light and under the microscope, through the medium of a plate of Iceland crystal, presents a black cross, the centre of which coincides with the hilum.

The following table shows the form of the principal varieties of amylaceous matter, as well as their extreme diameters.

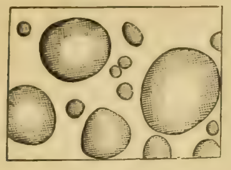
VEGETABLE SPECIES	FORM	DIAMETERS		
		maximum	average	minimum
		in thousandths of millimètres		
Chenopodium quinoa	lengthened ovoid.	—	0,002	—
Buck-wheat	polyhedral almost spherical	0,010	—	0,002
Beetroot seed	globulous	—	0,004	—
Oats	irregular polyhedron	—	0,020	—
Rye	lenticular	0,052	—	0,039
Chestnut	grape stone	0,025	—	0,002
Lentile fecula	—	0,060	—	0,002
Bread fruit tree	circular and polyhedral	0,0176	—	0,0044
Sweet potato or batatas	—	0,030	—	0,002
Indian kale	—	0,022	—	0,0044
Barley	spherical	0,040	—	0,001
Millet	angulous polyhed.	0,004	—	0,009
Broad bean fecula	reniform	0,040	—	0,004
Kidney bean fecula	reniform	0,065	—	0,004
Vetch fecula	—	0,066	—	0,004
Pea fecula	—	0,070	—	0,004
Manioc flour	elliptical rounded on one side	0.040	—	0,010
Rice	sharp-edged polyhedron	—	0,010	—
Arrow root	piriform	0,065	—	0,010
Sago	ovoid with plane section	0,080	—	0,030
Maize	rounded polyhed.	0,030	—	0,024
Banana fecula	ovoid and cylindrical	0,075	—	0,044
Horse Chestnut fecula	lengthened pear	0,030	—	0,0044
Wheat	spherical	0,050	—	0,045
Curcuma	flattened oval	0,070	—	0,060
Potato fecula	ovoid	0,185	—	0,050
Canna	varied	0,140	—	0,110

These dimensions are indicated by commencing with the smallest grains and by guiding ourselves by the largest diameter.

PLATE I.

DIFFERENT STARCHES SEEN UNDER THE MICROSCOPE.

Fig. 1.



Wheat.

Fig. 7.

Fig. 2.

Maize.

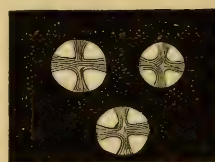
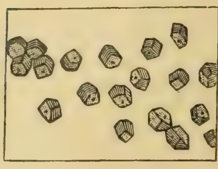


Fig. 8.

Fig. 3.



Rice.

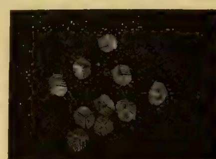


Fig. 9.

Fig. 4.

Potato.

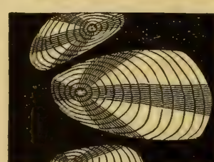
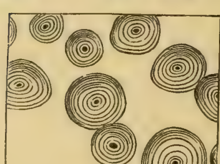


Fig. 10.

Fig. 5.



Tapioca.

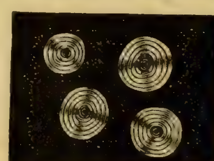
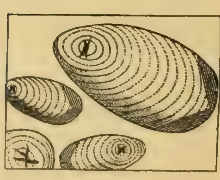


Fig. 11.

Fig. 6.



Sago.

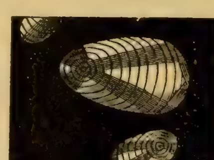


Fig. 12.

Plate I, Fig. 1 to 12, indicates the form of the principal starches, magnified 600 times; of all these kinds, rice starch alone appears without hilum and central cavity. Polarization, remarkable in the other plants, is absent in this one.

Starch, mixed with about 12 or 15 times its weight of water, commences to swell towards 40°, centig, the granules increase in volume, the liquid thickens and lastly the exterior layers burst and the paste is formed.

The accompanying table indicates the temperatures at which these different phases are produced in the following bodies. —

	SWELLING	COMMENCEMENT OF THE DISAGGREGATION	END OF THE DISAGGREGATION
Potato starch	46° C.	58° C.	62° C.
Maize	49	55	62
Wheaten starch	50	65	67.5
Rice "	54	59	62
Chestnut "	52	56	59
Rye "	45	50	55
Sago	—	66	71
Arrow-root	66	66	74
Arum arrow-root	50	58	62

Indian corn or maize starch gives, weight for weight, a stiffer size than wheat starch. It was first employed in North America, then in

Brazil and lastly in Australia. — It replaces, advantageously to-day in these countries, all other sorts of starch (*L. Wiesner*, "Rohstoffe des Pflanzenreiches". Leipzig 1873). It was discovered by *Collemann* in 1842. — Indian corn starch is well manufactured at the present time. Some years ago it was very gritty.

Acorn and chestnut starches have been tried, but without success. It would be useful to renew these experiments, considering that the process of preparation and the means of destroying essential oils are now carried to great perfection, and that these starches give excellent paste.

Amylaceous matter exists in all the organs of plants, and by our enumeration of the plants, which contain large quantities of it, we shall see that the field for experiments, to replace wheat starch by that of non-alimentary plants, is very vast.

Starchy matter exists in bryony, bordane, rhubarb, carrot, liquorice, manioc and jalap roots; in rice, canna, mace-reed, stems; in the tubercules of the gallingale, arum, arrow-head; in lily and tulip bulbs; in the medular part of the stem of the palm-tree; in the fruits of the oak, chestnut, buck-wheat; in the leguminous seeds, such as the lupine; in the cereal grains, barley, oats, millet etc. (1)

See Bernardin. — Melle. les-Gand, *Classification de deux cent cinquante fécules* 1876.

This short treatise is most interesting with regard to plants, yielding starchy substances to be employed in industry. — The author gives a great deal of information on certain starches, employed in fairly large quantities, but which pass unperceived in commerce, either because they serve to falsify or are sold under other names than the correct ones.

Starch is a constituent part of all plants, which contain chlorophyll. It is formed by the influence of light, and strange to say it is sometimes in a soluble and sometimes in an insoluble state, according to the stage of the plant. Starch is found in the state of dissolution when it is transformed either into sugar, gum or cellulose or as a fatty matter, to pass to the insoluble state, when it becomes a nutritive principle for an ulterior vegetative period. The formation of starch and its different transformations in the body of the plant are still unknown. It is known however that starch is transformed into sugar by the effects of frost, also that sugar is formed at the time of the ripening of the fruit.

De Candolle has demonstrated that it is at the period of the maturity of potatoes, that the most starch is found, which decreases after maturity in the same proportion as it increased before that period. It is also remarkable that the parts exposed to light always contain less starch than the subterranean parts.

According to its origin, flour is a mixture of granules of various forms; microscopic examination shows that it is composed of layers, whether concentric or excentric. Each granule of starch is composed of a cellular envelope of cellulose and granulose.

Cellulose is insoluble in acids and malt, and is not coloured by iodine: granulose, on the con-

trary, is coloured by iodine, and is soluble in acids. The cellular envelope is of the same composition as cellulose.

Starch is met with in commerce under different forms.

I In the state of powder; it is then called »*fleur d'amidon*« and is used in perfumery.

II Under the form of irregular prisms called *needles;* when these needles are very long and fine they are designated under the name of *crystal starch.* —

Starch, when pure is a white, tasteless odourless powder. It is insoluble in water, alcohol, ether, chloroform and oil. Its density is 1.505. Starch powder is very hygroscopic, and can absorb as much as 36% of water. The starch of commerce generally contains 12%. The chemical formula is $C_6 H_{10} O_5$, that is to say, it is a ternary compound, in which hydrogen and oxygen are found in such proportions, that combined they form water. By its elementary composition, it is identical with cellulose, from which it differs only by its structure and cohesion. (*Pennetier* p. 90.)

Concentrated nitric acid dissolves starch, an addition of water precipitates an explosive matter, *Xyloïdine*, which has been employed by the General *Uchatius* to prepare the white powder, it is also called *Pyroxam*. By ebullition the same acid converts starch into oxalic acid.

Starch is soluble in glycerine.

Tannin and concentrated decoctions of astringent matter have the property of forming, with the starch, a composition, soluble in almost boiling water, but which is precipitated below 50^{0} in grey opaque flakes, which form, when united, a kind of magma. Acetic acid is opposed to the precipitation of *tannate of starch.*

Iodine has the property of rendering starch permanently soluble in cold water; this fact, demonstrated by Dr. *Quesneville*, led hin to prepare the *iodure of soluble starch.* This body is presented under the form of a very fine black powder, which dissolves almost entirely in water, giving a magnificent blue liquid.

The experiments of *Naegèly* have shown that starch is composed of a series of isomeric compounds, which are coloured by iodine in the following order — blue, violet, red, orange, yellow. — Colouring, by iodine, according to the same author, is not owing to a chemical effect. It is a simple mechanical separation of iodine by starch.

An interesting transformation of starch, and one on which we must speak more fully, is that which is produced by the action of dissolution of soda or potash. Starch treated with soda, constitutes, when cold, a paste thicker in proportion to the concentration of the soda. The operation is finished in about 2 hours; this paste can be neutralized by the addition of acid, and can be brought to any consistency. — This same paste

can be used in an alkaline, acid or neuter state It may even be used to thicken colours. — One of its great qualities is to form a size, that water cannot take off. Tissues, sized by this method, remain stiff even after several washings. Another advantage is, that it has no influence on colours, when neutralized, and it does not promote mildew. — Divers names have been given to this product, among others, that of *apparatine*. — (See *Muster-Zeitung* 1872, page 123 — and Dr. *Ure* »Dictionary of Arts and Manufactures« vol. IV, pag. 80.)

Apparatine is presented under the form of a transparent, pasty mass, which, when dried, has the appearance of horn. It is prepared as follows. To 76 parts of water are mixed 16 parts of good »farina« or starch, it is indifferent which is used, as the result is the same, only the time for mixing varies, and 8 parts of caustic soda at 25^{0}B^é. The starch and water are first mixed together, then the lixivium is added by degress, being stirred all the while. After some time the liquid becomes clear and gives a strong jelly. The more it is stirred, the better is the jelly. So prepared, the apparatine resembles a sort of jelly, analogous to tragacanth gum. When exposed to air, it neither turns sour, nor acquires a disagreeable smell. In cooking it swells and thickens still more, whilst retaining its primitive qualities. When dried, cakes like those of glue or albumen may be obtained, which can be easily bent or folded.

It may be used for either silk, woollen or cotton fabrics. It will also give an excessive metallic stiffness. Tissues prepared with apparatine, after 2 or 3 washings, will not lose their stiffness. Two or 3 washings even in hot water will hardly change it; it is a perfect substitute for gum, starch stiffenings, glue etc. and mixes very well with any of these products. — Special attention is drawn to the preparation and the mode of using this product, not only because of its low price and very large yield but also because of its properties which render it so valuable in finishing.

Boiled starch is frequently used with caustic soda, which gives a clear, transparent paste, although not so good as the apparatine.

Potato starch or »farina« is one of the substances most valuable in finishing; it is true that it does not give a very thick paste and that some other starch must be added, but, for light styles of finishing it is a product that cannot easily be replaced. This starch has another advantage, when pure it does not generate mildew so easily as the others.

Dextrine is a modification of starch.

All diluted acids, except acetic acid, convert all the varieties of starchy matters into dextrine towards 100°.

Starch is alike transformable into dextrine and sugar by sprouting barley. It is a principle called *diastase*, which determines this transformation.

The power of this body is so considerable, that according to Dubrunfaut, one part of diastase can render the insoluble substance of two hundred thousand parts of starchy matter, soluble in water, or transform into saccharine matter ten thousand parts of dry starch.

It was long thought that starch was changed by diastase first into dextrine, then into glucose. According to *Musculus* the two bodies appeared from the very commencement of the operation, and as a final result, a mixture of glucose and dextrine, in the proportion of one part of glucose to two of dextrine was found. According to the same chemist diastase does not act on pure dextrine.

The property of diastase to convert starch into dextrine suggested to Mr. *Mathias Paraf* the idea of unsizing goods in the following manner.

For 600 metres of calico a filtered infusion of 6 or 700 grammes of sprouting barley is used, it is heated during half an hour at the temperarature of about 50°.

Diastase is also used to remove starch coming from the dressing in grey goods.

Dextrine by itself does not give a very stiff finish, it should not either be used in too large doses, and care should be taken in preparing it not to exceed a certain proportion in finishing mixtures. — We know that finishers, who because they have not taken into account this fact, and wished to force the proportions of dextrine, that

they had prepared themselves, obtained a finish much too sugary and giving a sticky feel. The inconvenience of this is seen only after a certain time, and especially if the goods are put in a damp place. The material becomes flimsy and loses its appearance. On drying, it recovers its stiffness, but the slightest humidity will make it flabby, and the folds of the piece will stick together.

It is very necessary to, thoroughly examine dextrine, not prepared by ones self, for it contains untransformed flour and glucose in a smaller or greater proportion. This is indicated by the reduction, excercised on *Fehling's* liquor. Alcohol at 90^0 is then poured on the sirupy dissolution, which precipitates the dextrine and the untransformed starchy matter, it is filtered, washed with pure alcohol and dried. By the cold water treatment, the dextrine alone is dissolved and is again precipitated by rectified alcohol. (*J. Girardin*, Chimie appliquée aux arts industriels, Vol. III, page 213.)

The admixture of different starches or flours can be detected by the microscope, but one needs to be accustomed to the use of the instrument. Recourse can be had to the following methods indicated by *Mayet*.

A paste is made with 5 grammes of starch and 50 grammes of water, it is allowed to come to a boil. The paste will be of a dull, white colour and will thicken promptly, if it is made of *wheat-*

starch. — *Rice starch* will thicken much more slowly. The action of *Indian corn starch* is nearly the same, it thickens however less slowly than rice starch. *Farina* gives at once, even when hot a very transparent and thick paste, but which separates rather quickly.

By adding to 50 centigrammes of each of these different starches, 15 drops of a mixture composed of 5 drops of iodine and 50 grammes of distilled water, it is observed that;

wheat starch becomes very rapidly of a *pink* tint *which lasts for a pretty long time.*

Indian corn starch also becomes of a *rosy* tint, *which however disappears almost instantaneously.*

Farina takes a beautiful *blue* tint, which passes pretty quickly to a deep violet.

Calcined starch is a modification soluble in white starch water, and is sometimes used in finishing. It is employed for dark styles of finish, which have no white and where there is no fear of the colours being tarnished.

Leiogome or calcined flour resembles calcined starch by its qualities, but it is more gummy and is but little used in finishing.

Rice and Indian corn starch are sometimes calcined. These products are designated by the name of »British gum«. It is so called because dextrine and its derivatives were discovered in England by a most fortuitous circumstance.

The fabrication of potato flour was, from the very beginning, badly received by the working class in England. On account of the enormous increase in the quantities consumed of this tubercle, the people feared that the price of this principal alimentary substance would be raised. There were in consequence frequent incendiary fires.

The 5th of September 1821, there was an incendiarism of this kind at Chapelizoo near Dublin in Ireland. The conflagration was but partial, the storing rooms were saved, but they were so inundated, that from them streamed real rivulets of starch, which flowed to and was lost in the Liffey, a river which traverses Dublin.

A workman in one of the neighbouring print works, who had helped in the extinction of the fire, prepared to dress the next morning to go, as usual, to his work; but to his great surprise, it was impossible for him to put on his clothes, for wet the evening before, they had now become perfectly stiff and had the appearance of linen that had been soaked in gum. He returned to the scene of the accident, and on examining the debris he noticed brown, yellow and white clots of flour. He tried to dissolve them in water and to his astonishment succeeded. Four other workmen, present, joined with him to buy flour which they calcined in a saucepan, then attempted the dissolution of this product in water. The experiment succeeded. Dextrine and calcined starch or *British gum* was discovered.

They sold the process at Manchester, then emigrated to New-Orleans. A short time after the principal author of the discovery died. The secret was then communicated to a friend, a clever speculator, who returned to England, where he produced and sold great quantities of this product. Fearing that his secret might be divulged, he divided the operations into different series, executed by special workmen, all communication between them being cut off. This way of working attracted public attention, and one fine day the manufacturer was surprised in his work by the excise officers, who pretended that he was manufacturing a forbidden product. He was smart enough to ward off all the trouble and worry showered on him, and for a long time succeded in boffling attempts to discover his secret. But one day pressed by a print manufacturer who claimed the immediate delivery of the ordered product, he, although ill, desirous to oblige, commenced the operation in the presence of his customer. This latter rapidly possessed himself of the secret of this process and never ordered any more British gum. Two years after it was produced by a dozen manufacturers.

It is on account of its transformation into dextrine that starch is used for stiffening. By the drying process the paste loses its water and there remains only a kind of envelope composed of starch, which is partially changed into dex-

trine by the heat of either drying frames or calenders.

The other starches or feculas that are sometimes, although rarely, employed, are the following.

Arrow-root, name specially applied to the starchy matter of the roots of the *Maranta arundinacea*, of the *Curcuma angustifolia* and *Tacea pinnatifida*, plants of the Antilles, Taiti and the East Indies.

Sago comes from the pith of several palms of the Moluccas, principally from the *Sagus rufia*, *farinifera* and *Cycas circinalis*.

It is met with in commerce in several forms; the reddish sago tapioca, which yields in water a starchy matter, may be colored by iodine. — The Sago, in pink or white granules, which yields nothing in cold water.

The produce of the sago-trees is considerable. Seven trees yield as much nutritive matter as a hectare (2 ac. 1 rood, 35 perches) of wheat, and six times more than a hectare of potatoes.

The Chinese of Singapore annually convert more than 20.000 tons of pith into flour. England alone receives thence more than 12 million kgs. (*Pennetier*: Leçons sur les matières premières.)

Tapioca, also called *Moussache*, *Cipipa or Cassava starch*, is extracted from the root of different maniocs, from the *Jatropha manihoit*, a medicinal manioc and from the *manihoit aïpi* or sweet

manioc, largely cultivated in Africa, in the Indies, in Bourbon, Java and China.

This produce is met with in two distinct forms. One, called *Moussache*, is a fine powder of a dirty, white; the second, called *Tapioca*, is in very hard, white or reddish irregular lumps. The number of persons who live almost exclusively on the flour of the manioc in the form of divers preparations exceeds that of people living on wheat.

Salep is the hulled bulb of several kinds of orchids; it comes from Persia and Turkey. It is somewhat used in Germany for certain kinds of finish.

The *stiffening* or *thickening* power of the different starches, of wheat, maize and potatoes has been tested by *Wiesner* of Vienna. Although we cannot discuss the real value of these tests made on a small scale upon Linen yarns, we will howewer mention them, because they agree fairly with the results obtained in practice.

The different qualities of starch to be tested were kept in a dry place for some time and then weighed. The quantity of water found in each starch was as follows:

Wheat starch	13·91%
Maize starch	14·77%
Potato starch »Farina« .	14·07%

Pastes were made with the proportion of 1 gr. of matter to 15 gr. of distilled water, then cooked in a »bain marie«, being continually stirred.

The farina was first dissolved, then the maize starch and lastly the wheaten starch; as soon as the farina was transformed into paste it was taken off the fire. The two others were boiled until they came to a complete paste.

The three dissolutions were allowed to cool before being employed. These prepared pastes contained the following quantities of water:

wheat	87·77%
maize or Indian corn . .	91·19%
potato farina	94·20%

The author sized some threads and the following results were obtained. The maize paste, the proportions being equal and the operations similar, gives the stiffest sizing, and the farina the weakest; — the farina and the maize size more regularly than the wheat, probably owing to the constitution of wheat starch, which is composed of different sized granules, whereas those of the maize and potato differ but slightly. —

All starches or feculas employed in sizing ought to be examined. It is important to know if they are well washed, sour, falsified or adulterated.

The smell, colour, specific gravity, the desiccation in the drying stove to discover the per centage of water, the changes they undergo in mixing them with water, the calcination which should leave but little ash, (Starches give from

1 to 2 per cent of ash, farina 1·4 percent) generally give indications sufficient, for the sizer. For more exact and precise information we refer to the special treatises on the tests of these bodies. (Dictionnaire *O. Lami*. Essai des drogues. Dictionnaire des altérations et falsifications, *Chevalier et Baudrimont*. Dictionnaire des falsifications, *Soubeyran*. and the English authors.)

Flours of all kinds are also employed in sizing but more especially in that of yarns; the fabrics being too susceptible to mildew, resulting from the decomposition of the gluten. The manufacturers who employ flour, often ferment it before using so as to destroy or eliminate the matters containing azote.

The following table will show more clearly the advantage of using starchy matters ready prepared, in preference to the flour of the same plant; we will only indicate here the three substances most generally employed.

	WHEAT		MAIZE		RICE	
	FLOUR	STARCH	FLOUR	STARCH	FLOUR	STARCH
Water	16.50	15.87	14.00	17.44	13.00	18.42
Fatty matter	1.20	—	8.10	—	0.70	—
Gluten	11.08	—	11.10	—	6.30	—
Starch	66.27	82.81	65.18	81.59	79.50	80.75

Dictionnaire des analyses chimiques. VIOLETTE & ARCHAMBAULT.

Casein, which is obtained by the action of rennet on milk, and gluten, a substance containing azote found in most plants, are seldom or never used. The *albumen* of eggs, mixed with starch, is sometimes used for certain kinds of finish, the price of which allows so expensive a treatment, but the drying process must be thoroughly carried out to 75° at least, in order that the coagulation of the albumen be complete.

Gelatine, an immediate principle, obtained by subjecting cellular tissue, hides, tendons, gristle, etc. to the prolonged action of boiling water, is also employed in sizing. There are different kinds: viz *Isinglass*, *Cologne and Russian Glues, Glove Glue, Calf's head* etc. Its use is greatly restricted, owing to its being so easily decomposed, and on account of the disagreeable smell it imparts to the fabrics. This latter inconvenience may be partly avoided by first washing in several waters which are thrown away and the remaining dissolution used.

Sea-weeds, Iceland moss or their decoctions produce jellies which fill the goods fairly without tarnishing them. — These substances retain the properties necessary for stiffening or starching, but in general the finishing, effected with these products, is flabby. They are not employed alone except for certain styles called *satins*.

Hai-thao or *Gèlose de Payen* comes from a Java sea-weed (*Gelidium corneum*, Lam.) and gives a supple and rather strong size which imparts

consistency to the cloth, and fills the yarn more than farina and dextrine.

A very supple and soft size may be obtained from a solution to which has been added some glycerine. The only drawback is that this substance must be used hot.

The materials prepared with thao are not impermeable to water, but if wetted after finishing they retain a stiffness which those prepared with farina or dextrine do not. — (Les différentes espèces de thao. Thèse de Mr. *Lebas*. Rouen 1880.)

Gums are exudations from fruit trees and from the different varieties of acacias which grow in Senegal, India, Egypt, Java, whence come the names of *Gum Arabic, Gum Senegal, Native fruit tree Gum*. They give very clear dissolutions and are employed for the finishing of light materials, but seldom for cotton on account of their high price and the harsh, stiff finish they give.

Gum-Tragacanth, also an exudation from small shrubs, called *Astragalus*, which grow in Asia Minor, is the most used. It possesses the advantage of not tarnishing the colours and of giving body without stiffness. — Gum Tragacanth, to be well disaggregated or swollen, must be boiled for several hours after having been macerated in cold water during twenty four hours. — It must be boiled until the liquid becomes very homogeneous

and smooth, it may also be boiled in a closed boiler at 4 or 5 atmospheres; at the end of a quarter of an hour or twenty minutes the desired result is obtained. — This remark applies also to the preparation of starch paste. (Traité des matières colorantes. *P. Schützenberger*, Tome I, page 99.)

2. Emollient, softening or hygroscopic substances.

Glycerine, glucose. — Olive oil, cocoa-nut oil, emulsive oil, Turkey red oil, fatty matters — tallow, stearine, paraffin, spermaceti, — beeswax, Japan wax, ozokerit, dulcine, »parement Freppel,« Soda ash, ammonia, chloride of calcium, chloride of zinc. —

We need not dwell upon these various products, the action of which is so well known. — The one most generally used is *glycerine,* because it facilitates the application of the paste, renders the material softer, more supple, unctuous, and gives more regularity to the damping. It is important to examine the glycerines used in trade, for productions so named are often met with, which contain no traces of glycerine. These are mixtures of glucose, chloride of magnesia etc. — Glycerine has the immense advantage of mixing with almost all bodies. The only insoluble substances and those

which are not for the most part utilized in finishing are: ioduret of lead and mercury, calomel, sulphur of carbon, chloroform, ether, fatty and essential o ls, fatty acids, resins and carbonic acid.

Glucose or grape sugar gives suppleness as well as a little weight but it must be employed with the greatest care. It may cause serious inconveniences and damage the goods, with regard to mildew as well as humidity, which it absorbs and which disfigures the goods. —

In cheap styles, not fast colours, it facilitates the reapplication and the discharge or running of colours, even after having been some time in the warehouses.

The *fatty matters* as *tallow, stearine*, *soaps* etc. are used to diminish the stiffness of the cloth and to render it more supple. By using them the dose of stiffening paste may be increased, without rendering the tissue too harsh, and the yarn is better *filled* although not yet heavily sized; also heavy matters such as china-clay, plaster etc. may be more easily incorporated. Without the fatty matters the fabrics would become too dry, too rugose and brittle.

Care must be taken not to use the alkaline earths with pastes prepared with fatty matters, as these latter substances form insoluble soaps.

Alkalis (*Salts of Soda*, *Sodaash, Salammonia)* serve to neutralize the acids if they have been directly

introduced into the preparation of dextrine, or if they come from fatty matters which, unless changed into soap, would not mix thoroughly with the paste. The fatty matters cause the paste to adhere to the drums. — To avoid this inconvenience the drums are covered (the 1st and 2nd) with blanket or lapping, which can be easily removed, whereas the washing of the drums occasions a great loss of time.

Waxes are employed in finishing as softenings and also to prevent the adherence of the paste to the drying cylinders. They are especially used in the kinds of materials destined to be glazed.

Dulcine, mixture much used in England, is a composition of glycerine, gommeline and Japan wax; the properties of its components are attributed to it.

Parement Freppel which has had its day gives consistency and suppleness to the fabric. It is a mixture of Iceland moss jelly and glycerine, to which a little bi-sulphite of soda is added to act as an antiseptic.

Chlorides of zinc and calcium simply play the part of hygroscopic substances. Very little must be used, for the chloride of zinc may decompose and weaken the fabric, and when it is added in too large quantities the tissue becomes too soft, (see the chapter on antiseptics and that relating to mildew).

Chloride of sodium is used as a hygroscopic substance, it is also employed to give to cotton goods crispness and a silky finish; it is likewise utilized to give to the stuff a particular feel. The interior of the piece becomes cold and appears damp. —

3. Substances used to fill or to give weight.

The principal qualities that a body destined to give weight in finishing must possess are: a fine white colour, in a tenuous powder, of a moderate price, insoluble in water and in the ordinary agents used in finishing, it must not be influenced by the emanations generally found in air, nor must it be poisonous.

The bodies possessing these qualities are:

China-clay, whiting or chalk, gypsum, talc, steatite and kaolin. These substances are those most generally employed.

China-clay is an argilaceous earth, produced by the decomposition of the feldspath or spar of granite rocks. — It was formerly belived to be possible to use it as an imitation of China porcelain (whence its name). — It is a silicate of alumina. The finishing of fabrics and the manufacture of paper-hangings absorb almost the whole of this product.

The exact consumption of this production in England is not known, but this country exports annually quantities of it to the value of more than three and a half million francs. — In 1875 *Cornwall and Devon* shipped more than 125.000 tons.

The other products named are also utilized but in smaller quantities, for they are more expensive and do not yield so well.

Talc and *steatite* or soap-stone are silicates of magnesia.

Kaolin is a silicate of alumina.

The insoluble *sulphates* of *barium* and *calcium*, the *carbonates* of the same base are also employed but more rarely; *sulphate of lead* is also used but it is dangerous in a hygienic point of view, and is turned black by sulphurous hydrogen. — *Sulphate of zinc* is equally injurious to health. (see Bulletin de la *Société industrielle de Rouen* 1874. p. 335.)

Several soluble sulphates as *sulphate of soda* and *sulphate of magnesia* are also utilized, but as they are soluble and colourless their yield is not so considerable as the clays.

During the past few years *artificial cellulose* has been employed in Germany. — Its use has caused serious inconveniences. Large yellow spots are formed after the drying process; these spots appear to be analogous to those formed by steaming of fabrics, too much chlorined in bleaching. They are probably owing so a partial conversion

of the cellulose into oxycellulose. On account of the unevenness which it frequently occasions it has been abandoned and replaced by clays.

Cellulose, well treated and especially well-washed and in a tenuous powder might, it seems to us, give good results.

4. Colouring matters used in finishing.

Size being sometimes colourless and at others coloured, it is indispensable to add colouring matters which hide the colour of the latter, whilst in other cases it is necessary to add those which increase the degree of colour of the material, that the colourless size would otherwise render dull. Such is the case in self-coloured fabrics. In the finishing of these goods, mineral matters are mixed with the paste which heighten the tone and dissimulate the thickening. (See the samples Nrs. 58 and 62.) In other cases the yellowish tone of the white is rectified by a slight addition of blue.

In the last century *Indigo blue* was principally employed; the *new blues* derived from *aniline* and soluble *Prussian blues* are still used. — For »Domestics« and madapolam the white is heightened by the use of *ammoniacal cochineal; cobalt blue* is also used. It is a resisting and very lasting composition. It is daily employed in the blueing of the lace and guipure manufactured at St. Gall. —

It is to be regretted that it is sold at such a high price.

A beautiful blue of a moderate price, resisting acids, alkalis and light, is one of the desiderata of the industry and for many years »La Société Industrielle« of Mulhouse has offered a prize, open to all, for the solution of this problem, without having as yet the satisfaction of awarding the promised recompense.

All the bodies we have just reviewed are eclipsed by the artificial ultramarine. — It is the body pre-eminently employed in the treatment of cotton goods, and on account of its importance we will study it more fully.

The beautiful blue colouring matter known in commerce under the name of artificial ultramarine is one of the most remarkable discoveries of chemistry. This discovery, which dates from 1822, but of which *Tassaert* had already an idea in the soda ovens at *St. Gobain*, has resulted in the creation of a branch of industry, which yearly increases. — Ultramarine discovered almost simultaneously by *Gmelin* 1828 and by *Guimet* 1826, but largely manufactured by the latter only, was sold when first put into the market at a very low price in comparison with the natural ultramarine or *lapis lazuli*. The latter cost 4.000 frcs. a kilo. The first ultramarine of Guimet was sold at 600 fr. per kg.; in 1831 at 30 fr.; to day the best brands cost from 2 fr. to 2 fr. 50, and this industry has

so greatly extended, that in 1886, there existed six manufactories in France, twenty one in Germany, five in Austrian-Hungary, one in Belgium, one in England, two in Russia, and three in Holland. Its uses are very numerous.

Ultramarine is used in different kinds of painting, typographic and lithographic printing, cloth finishing, in the manufacture of paper, wall-painting, blueing of linen, in washing, in the colouring of candles, sealing-wax, matches, paper staining and lastly in sizing or stiffening. We will treat of it as regards its uses in the preparation of starching and blueing which precedes the stiffening, in the chapter on chloring and blueing.

The *composition* of ultramarine is well-known and it is variable; silica, alumina, soda and oxygen are found in it. The silica and soda are elements the proportions of which remain most constant. On the contrary the sulphur and alumina vary considerably and the analysis discloses this fact that their variations have an inverse effect one on the other; *the sulphur increases when the alumina diminishes,* and it is stated at the same time with regard to the shade, that the increased intensity of the blue corresponds with the decrease of alumina.

As to the *constitution* of ultramarine, that is to say, the reciprocal position of the constitutive elements of this substance, it is still unknown; in spite of the numerous works (*Knapp*, *Hoffmann*,

Schützenberger, Ritter etc.) occasioned by research no hypothesis has yet triumphed over scientific criticism. (See the report of Mr. *Lauth* published in 1881 on the Paris Exhibition 1878).

Recent works of *Knapp* foretell the possibility of the preparation of ultramarine by humid means. (Berichte der Deutschen Chemischen Gesellschaft, XIX. Seite 871, and Journal für Praktische Chemie [2] 34. Seite 328-348.)

The constitutive elements of ultramarine can be replaced and Mr. *Morel*, of the works of Fleurieu near Lyon, has stated that the sulphur may be replaced by tellurium or selenium; he has thus succeded in producing the following series.

ULTRAMARINE WITH SULPHUR.	ULTRAMARINE WITH SELENIUM.	ULTRAMARINE WITH TELLURIUM.
Brown	Brown	—
Green	—	Yellow
Blue	Purple red	Green
Violet	—	—
Pink	Pink	Grey
White	White	White

Unger had already obtained a green ultramarine, the base of which is silver. — It has been concluded that ultramarine is not a single body, but that it forms a series of compounds. Indeed about six years ago Mr. *Ballin* prepared ethylic, amylic, allylic ultramarines; he also stated that,

by an inverse reaction, the chloride of sodium, reacting on ethylic ultramarine, transforms the latter into blue ultramarine, which appears to be identical with that of commerce.

Ultramarine is easily affected by diluted acids. Steam changes it after a certain time. When an excess of hydrochloric acid is poured upon it, it liberates hydrosulphuric acid and at the same time emitting a pungent smell, which produces an irritating effect on the eyes, sulphur being formed. Ultramarines, prealably mixed with a little alcohol, are more easily penetrated by water. Oil added to ultramarine colours will darken them and render them less solid. According to an observation made by Mr. *Camille Koechlin*, ultramarine is insoluble in *concentrated* sulphuric acid, which does not affect it. (Bulletin de la *Société Industrielle de Mulhouse* 1885, Novembre.)

Different derivatives of ultramarine are found in commerce, viz:

blue ultramarine,
green ultramarine,
violet ultramarine,
pink ultramarine.

There are also white and yellow ultramarines, but they are not used.

Blue ultramarine may be classed thus:

ultramarine with a decided blue tint,
ultramarine with a green tinge,
ultramarine with a violet pink tinge.

In blue ultramarines the following varieties may be distinguished:

Blue manufactured with kaolin is poor in silica, of a light shade and easily decomposed by a solution of alum.

Blue, manufactured with kaolin, rich in silica, resisting alum and other acid salts, but is decomposed by acids; it is of a pinkish tint.

A boiling dissolution of alum rapidly decomposes the ultramarines with a green or blue tinge, whilst those with a pink or violet tinge resist longer.

There are different methods for estimating the intensity and delicacy of ultramarines. We will remark first of all that ultramarines with a violet tinge are much more intense than those with a greenish or pure blue tinge. Intensity is measured by comparison. Take for instance 0.1 gr. of ultramarine to be tested and then add 1 gr. of sulphate of baryta. Compare in the same conditions with a blue type — the one that remains the most colored will be naturally the most intense. The two blues may be spread side by side on a sheet of paper and then flattened out with a horn knife; it may immediately be seen which is the most intense, by placing on each of these blues a small quantity of the other. By an optical effect the weakest appears as a whitish spot and the darkest as a greyish spot which easily strikes the eye.

Its resistance to alum is tested by submitting a determined weight — 0.05 gr. of ultramarine

for instance — to the action of a solution, saturated in the cold with alum, the time necessary for the total discolouration of each blue is noted and its degree of resistance deduced by the duration of the test.

The quality is discovered either by rubbing the powder on paper or by mixing a quantity in water. The quality is estimated by the time necessary for the complete settling, which is in proportion to the duration of time necessary for the formation of the sediment.

Another process due to Mr. *Benner* (Bulletin de la *Société Industrielle de Rouen* 1874 page 37) is very simple and exact. —

To 50 grammes of water put of each ultramarine to be tested, 2 gr. when in powder, and 4 gr. when in paste, moisten it carefully with a small quantity of warm distilled water, so as to form a homogenous paste, then add 300 gr. of lukewarm distilled water; pour each test into a glass vessel, capable of containing one litre, then soak in it a strip of white calico 5 centimètres wide by 40 centimètres long — care being taken that the powder be previously in a state of perfect suspension; immerse one end of the strip of calico to the very bottom of the glass, and fasten the other with a pin 30 centimètres above, so that it may not touch the sides.

After an hour the capillarity will have caused the most tenuous parts of blue to rise in the strip, and the blue coloration of the strip is obtained

and spread over a smaller or greater length, according to the fineness of the powder. After that, the glasses must be taken away, the strips dried and then compared; those of which the blue coloration has spread the farthest will correspond to the finest powders.

5. Antiseptic substances used in finishing.

The different compositions used, in the finishing of goods containing invariably nitrogeneous organic substances, occasion injury to the fibre. We will subsequently study this form of deterioration called Mildew.

Efforts have been made to avoid these accidents which often cause disastrous losses.

There is a series of bodies which preserve from alteration these organic nitrogeneous compositions, even in physical conditions, when the alteration would be easiest. These bodies generally act by preventing the development and multiplication of germs. The name of *antiseptics* is given to them. (Dictionnaire de chimie de *Würtz*, page 357).

The principal substances of this kind are: sulphurous acid, the sulphites, salts of iron, salts of aluminium, copper, mercury, organic substances such as creosote, phenol, tannin, salicylic acid, camphor, oxalic acid, arsenic and its acids, salts of zinc, chloride of sodium and of magnesium;

besides the above-mentioned bodies, we may also mention alkaline hyposulphites, nitrite of soda, salts of chrome, manganates, picric acid, strychnine, lastly several volatile bodies, which we will only mention to complete the nomenclature since, from the fact of their volatility, they cannot be employed, viz: hydrocyanic acid, benzine, naphthaline, odorous essences, amylic alcohol, sulphur and chloride of carbon. (Dictionnaire de chimie de *Würtz*, page 1229). Besides their volatility, some of these bodies are very dangerous, because of their poisonous or inflammable properties and are for this reason to be rejected.

Saccharine and borhydrine have lately been highly commended.

We shall now enter into a detailed examination of the action of each of these bodies.

Sulphurous acid. Alkaline sulphites. Sulphurous acid, sulphites and alkaline bi-sulphites are really antiseptics; but with time they are converted into sulphates and cannot be used for goods.

Salts of iron. Sulphate of iron is the only salt of iron that can be utilized, yet it is not of practical use; it colours fabrics and after a certain time tends to the formation of iron-mould: in time it may also attack the fabrics. Mr. *Fasteur* has discovered that, in certain conditions and in the presence of sulphate of iron, the *Penicillum glaucum* is easily developed.

Salts of aluminium. — There are but three of the salts of aluminium that can be used, the alum, the chloride and the sulphate. Colourless alums must be introduced in pretty large quantities or they do not react; coloured alums must be rejected on account of their colouring properties; the chloride may decompose and liberate the hydro-chloric acid which attacks the fibre; the sulphate, like the alums, must be used in large proportions in finishing; it has the defect of giving a disagreeable rough »feel« to the goods.

One of the alums which ought to be tested is the alum of zinc. We know of no tests made on this salt.

Salts of copper. — Of all the different salts of copper, the sulphate only acts energetically but it cannot be used with other substances as it decomposes and precipitates oxide of copper on the fabrics. It is especially applicable in the dressing of grey goods. It cannot be utilized for white or printed fabrics. We will remark by the way that it allows the development of fungoid growths, and it is often found in electro-typing baths.

Salts of mercury. — Whatever may be their utility in the prevention of mildew, they must be absolutely rejected on account of being a highly poisonous substance.

Creosote — is one of the most energetic agents, but as it evaporates, with time it loses its action. *Dr. Samson* (Sizing and Mildew in Cotton Goods.

By *Davis, Dreyfus and Holland*, 1880 page 236) states that size containing 10 gr. per litre does not mildew. Unfortunately the action lessens evaporation, and its strong smell renders it objectionable in finishing.

Phenic acid acts like creosote. Its odour is also a great obstacle to its general use as an antiseptic in the finishing of goods.

Tannin is wrongly recommended. Nothing is easier than to provoke fungoid growths on tannin solutions, which is daily seen on inks the base of which is iron and tannin.

Salicylic acid is one of the best antiseptics known, it is used to the average dose of about 10 gr. per litre. The size ought to be neutral. For coloured fabrics it is necessary to know if the colours are affected by this acid.

However after a certain time it appears to decompose under atmospheric influence. (Dictionnaire de chimie de *Würtz*, page 1399.) Its being colourless gives it a great advantage over creosote and phenic acid.

Camphor has but an ephemeral action, on account of its great volatility.

Oxalic acid and the oxalates are wrongly considered as preventing mildew. It is well-known that in dissolutions containing oxalic acid or oxalates, mildew is easily propagated.

Arsenic and its acids are most deadly poisonous substances, and as well as *strychnine* ought never to be used.

Salts of zinc are of all antiseptics those which may be considered the most efficacious, therefore they are used in considerable quantities. In England the chloride is especially used, in France the sulphate is employed.

We think the sulphate preferable, because it is not so hygroscopic and does not decompose so easily. The chloride of zinc must be used as pure as possible; some finishers add chloride of magnesium, but this admixture should be avoided as it would soon decompose, and the acid liberated wouid injure the material; chloride of zinc should be used alone. It is also very important that it be not mixed with the paste before the latter is completely finished and cold. In England they are accustomed to prepare the salts of zinc with china-clay. This method is very defective and considerably diminishes the antiseptic effect of the chloride.

The chlorides of sodium and magnesium are very good in finishing, their hygroscopicity gives moisture to it, but they do not retard the formation of fungi.

The *hyposulphite alkalines* are much too sensible to the contact of air, to be applied.

The *nitrite of soda* also decomposes and encourages, instead of preventing fungoid growths. The use of this body must be carefully avoided.

The *salts of chrome* although really antiseptic cannot be employed on account of the colour. They must moreover be used with precaution, because decomposed, they may give oxide of chrome or chromic acid, which would injure the tissue.

It is known that mildew is rarely produced on chrome yellows and oranges, this proves their efficacy. (See Bulletin de la *Société Industrielle de Rouen.* Note de *G. Witz* sur les piqûres. 1875, page 48.)

The *permangates and salts of manganese* have a certain action, but the permangates in decomposing charge the cloth with peroxyde of manganese, not very liable to be attacked by mildew, but highly coloured. (Dictionnaire de chimie de *Würtz*, page 1448. Les fermentations par *Schutzenberger*, page 181.)

These salts, like salts of copper or iron, can be easily precipitated, especially if the size contains substances with alkaline bases. Chloride even without being mixed is affected by the influence of light. (Dictionnaire de *Würtz*, page 295.) These salts cannot therefore be employed.

Picric acid colours too easily.

Lastly volatile bodies cannot be applied on account of their too great facility of displacement.

Of all the bodies which we have reviewed there are only the salts of zinc, sulphate of copper, phenic acid and salicylic acid which can be used with certitude; even with these bodies great care

must be taken to choose the one most favorable for the different fabrics, and the style of finish required.

In dressing and sizing preference is given to salts of zinc and copper.

In the finishing of white fabrics alums and salicylic acid are used. In printed goods salts of zinc, when they have no action on the colour, or salicylic and phenic acid; boric acid and borates are used, but they have no antiseptic effect, that is why we have not mentioned them in the list of antiseptics.

It is important to remark that, from a hygienic point of view, these bodies may be used indifferently. We must not lose sight of the fact that salts of zinc are very dangerous, whilst alums and salicylic acid are innocuous, so to speak, considering the small quantity used.

In the chapter on Mildew we will speak of *Saccharine*.

6. Substances used to make fabrics impermeable to water (waterproof.)

It is superfluous to enter into more details on the subject of the character of these bodies.

Those which can really render service are resins, fatty matters, hydrofuge matters of all natures, dissolutions of india-rubber, gutta-percha, salts of alumina, siccative oils and waxes.

We must however remark that this expression of »impermeable to water« is ambiguous. — A tissue can be sized so as not to let water pass, provided it is covered to some degree by an impermeable coating; but on the other hand the fibres of a light tissue can be covered with impermeable substances and yet let water penetrate, which is due to the intervals between the different threads not being filled up.

The question of impermeability has little importance in the finishing of cotton goods. It is especially in fabrics, destined to serve as exterior clothing that this quality is sought after; the fashion which brought in favour woollen goods called, »waterproofs«, appears to have completely set aside this sort of finishing. It has also been recognized that they were not hygienic, and that they prevent the evaporation of the secretions of the body.

7. Substances destined to render tissues incombustible (fireproof).

For some time much attention has been given to render tissues incombustible. This grave question occasioned the taking out of a large number of patents. Tests made on a small scale appear satisfactory, but unfortunately, when a serious fire breaks out, the results do not answer the hopes which have been founded on these processes.

It is difficult to state precisely the character of the bodies that have been especially commended;

we will limit ourselves to quoting simply those which appear the most appropriate to this purpose. Besides the general information, which we will at once give, we will indicate in the chapter relative to the processes some formulae which are considered as accomplishing this end. Experience alone will show if these preparations justify the pretensions of their authors.

One of the most ancient salts employed was phosphate of ammoniac. According to Mr. *Chennevier*, (Bulletin de la *Société Industrielle de Mulhouse* 1883, pages 298 and following) from whom we have taken the following information, a certain Mr. *Arfird* in 1786 indicated, to the Duke Frederic of Brunswick, a process rendering wood and stuffs incombustible. This process consisted in immersing the tissues and wood in a dissolution of phosphate of ammoniac.

This method is hardly practicable because the phosphate of ammoniac affects colours and fabrics and in decomposing at red heat will give phosphorus, which can but increase the combustion instead of checking its progress.

This idea was however revived a few years ago, but it met with no greater success than at first.

The silicate of potash or soluble glass has been recommended by *Fuchs* in 1820. It is certain that a sufficiently concentrated dissolution of this body, applied to combustible materials will deprive them of their power of ignition.

The material thus coated becomes vitrified by the heat and thus prevents the contact of air.

When the theatre at Munich was rebuilt, this preparation was used, but it is probable that if it has not been renewed the protective or refractory power of the solution has long since been destroyed.

In 1821 *Gay-Lussac* affirmed that certain soluble salts, when the solution is spread on cloth, prevent it from flaming; and he proposed that all the decorations of the theatres be coated with them. This great authority recommends the use of phosphates, especially of ammoniac, and also a solution of borax, mixed with ammoniacal salts; but the borax renders the tissues hard and falls off in dust on account of its efflorescence.

This substance is actually employed in large quantities by laundresses and it gives to linen, when ironed, a stiffness and brilliancy, much appreciated. These workwomen thus render the linen got up with this special starch, in some measure incombustible.

Mr. *Morin* proposed oxide of zinc.

Mr. de *Bréza* in 1841 recommended a solution in which the fabrics should be soaked, and which was formed of 60 gr. of alum, 60 gr. of sulphate of ammoniac, 30 gr. of boracic acid to one litre of water. — To this was added 19 gr. of gelatine and 6 gr. of starch (?).

Alum weakens very fine fabrics renders them delicate and liable to be torn.

In 1856 Mr. *Th. Masson* proposed chloride of calcium . . . . . but if this salt is indecomposable in the highest temperature, it is also deliquescent, which makes the possibility of employing it improbable.

This difficulty might perhaps be overcome by mixing the incombustible matter with an agglutinant like gelatine, which would hold and fix it in thin layers on the parts to be preserved.

Sulphate of ammonia and tungstate of soda were examined in 1859 by Mess^rs.^ *Wersmann and Oppen*; but the former produced dark spots when the cloth contained iron, and the expensiveness of the latter will restrict its use.

The numerous and interesting experiments of Mr. *Carteron* concerning the processes of preparation of fabrics, intended to render them uninflammable, if not incombustible, by the use of tungstate of soda were greatly talked of in 1857-58-59.

They were even the object of a favorable report of the inspector general, in consequence of which the »Conseil général des batîments civils« expressed its opinion in the following terms:

« Considering that the processes of Mr. *Carteron*
« to secure light matters stuffs etc. from in-
« stantaneous conflagration are incontestable, is of
« opinion;

« That these processes be recommended to « the attention of the superior administration, « because of their various advantages.

Later on, the »Moniteur Universel« of the 2nd December 1859 contained an order of the State minister decreeing that, for the future, »the « costumes and decorations of the Opera must be « made with the materials of Mr. *Carteron* and « prepared according to his system.

We cannot say whether this decision was carried out, or whether the efforts of the inventor failed on account of inertia and general indifference; but it is certain that in 1873, the date of the burning of the Opera, the fire broke out in the room where the decorations were kept and that nothing was saved. If the light materials had been properly saturated or covered with Mr. *Carteron's* preparation, it is possible that the flames would not have spread.

It is known, however, that coatings, varnish or incombustible solutions will weaken in time and in a brief period, will lose their refractory properties, shell off, fall to powder and disappear. — Possibly the preparations had lost their anti-combustible power, or what is more probable, they had not been applied to the hangings, through neglect, for some considerable time.

The idea of employing tungstate of soda was not lost, being resumed by Mr. *Jones* in

1875, without, however, advancing the question in the least.

The »ignifuge« *Martin* is the latest anti-combustible process.

More modest or more tested than its predecessors, it does not aim at the complete incombustibility of the material it is employed to protect, but only at its non inflammability, which is a great point gained in preventing the spread of the flames, the dangers of which we have already pointed out.

The »ignifuge«, according to the inventor, is neither corrosive nor poisonous, it does not alter colours, even permits the addition of others and moreover it is cheap.

For its base it has a fixed saline matter, which Mr. *Martin* obtains by the chemical combination of completely inoffensive substances, which enter into the composition in various proportions, such as hydrochlorate and carbonate of ammonium, boracic acid, potassic feldspath, or spar, silicate of soda, all being mixed with starch, gelatine and »blanc de Meudon«.

The principal advantage of the mixture, which is applied with a brush as in painting, is that it will resist for a long time the action of a temperature varying from 40^0 to 50^0 (F 104^0 to 122^0), without deteriorating the uninflammable qualities of the substances coated over.

According to our own tests, materials first soaked in albumen, mixed with chloride of sodium,

silicate of soda and borate of sodium, and then vaporized, resist fairly well; but we hardly think this mixture, although greatly retarding combustion and preventing inflammability can be considered as an incombustible coating.

8. Substances employed to give a metallic lustre.

All the substances, which, we have hitherto examined, are incorporated in a uniform manner in the stiffening preparations and are spread evenly over the surface of the material to be treated Bodies for giving a metallic lustre are exceptions, being printed or applied to the surface by processes analogous to those in dyeing.

The products chiefly employed are coloured bronzes.

They are obtained in a pulverized form; 1^0 by mechanical means — by filing or grinding in a mill the metal already reduced by beating to the state of very thin leaves; 2^0 by chemical means, the component metals, which are generally copper, zinc, tin and antimony are precipitated from their salines solutions by the usual reducing agents.

To day, bronzes of all colours have been successfully produced: white, yellow, gold, copper, red, orange, violet-green and blue. These different colourations are obtained by annealing; the bronze powders

are heated in a vessel with fatty matters, such as paraffine, oil, and tallow, over a charcoal fire the whole being constantly stirred.

Blue bronze is obtained by a mixture of tin, antimony and copper, which after the fusion of the alloy is ground very finely and treated with sulphuretted hydrogen. At the end of ten hours the powder takes a golden tint, it is dried towards 200° C (392° F), when it acquires the pure blue shade, after having passed through all the intermediate shades.

Mica powder is also used, but crushed not pulverized, as in the latter state it would lose its brilliancy.

There are several ways of applying these bronzes to textile fabrics.

The cloth is sprinkled with resin, it may also be impregnated with siccative oil or a solution of caoutchouc, after which the powder is applied to the cloth through a sieve. When the stuff is partly dry, the non-adherent parts are taken off with a brush; if resin has been used the stuff is passed over a hot iron or heated cylinder; the resin melts and determines the local fusion, as well as the adherence to the bronze. Materials may also be gilded or silvered by covering them with siccative oil, and then passing them over a drum, containing the silvering or gilding powder. The most tenuous parts adhere to the oil, where they are allowed to dry, the excess being taken off

with a badger-hair brush. This is the process employed for paper hangings.

When leaves of gold or silver are used, they are placed on the goods previously prepared either with resin or oil, heated and brushed with a badger-hair brush, which takes off the non-adherent leaves.

A mixture of gum-arabic and bronze powder of the desired colour is also employed. The cloth is damped and hot calendered. The gum, becoming soluble through the action of the water, dissolves, and then, being dried by the calendering, retains the metallic substance. But this process gives unsatisfactory results, as the least drop of water will dissolve the bronze applied to the cloth.

Ordinary thickenings are employed in preference, (see chapter 2) starch, dextrine etc., casein, albumen, gelatines, different glues, siccative oils and lastly sugar.

The process due to *Wohlfahrth* consists in mixing one part of bronze with two parts of silicate of potash or of soda. — A colour is thus obtained, which is printed on the cloth, and allowed to dry; glycerine or syrup of sugar is added, if it be necessary to retard the hardening. — According to the author, neither water, sun, heat nor light will affect this impression.

According to *Rosenstiehl* a very simple but delicate method of obtaining regularity on a large scale consists in impregnating the cloth with a solution of a salt, giving a sulphide, with a metallic

tinge as antimony, lead or silver. The cloth is dried and then exposed to vapours of sulphuretted hydrogen, after which it undergoes a final calendering.

Mess[rs] *Agnelet* have devised the plan of placing on the fabric little drops of transparent gelatine, gum or varnish. The liquid holds in suspension little brilliant metallic scales, or plates of mica, mother of pearl, jet etc., which, by the play of light, give forth a vivid metallic lustre.

Lastly the argentine process, which is principally used for linings, materials in imitation of silk, for parasols etc. This process was tried for the first time in England in 1829; the powder, named argentine, which is nothing else than metallic tin in a very fine powder, is prepared in the following manner.

Arrange a set of from 12 to 18 cylindrical vessels, of 12 litres capacity; into each vessel put 10 litres of chloride of zinc at 15° Bé and 80 grammes of salt of pure tin. Some plates of zinc, placed in a parallel direction and fastened together at the top, so as to be easily taken out, are immersed in this bath. The reaction ought to take place very slowly, that is to say, it requires six or eight days — care must be taken to have a temperature from 10° to 16° centigrade, neither more nor less. The liquid must then be poured on a sieve; the metal, precipitated and washed by decantation, must be filtered, dried and sifted through a silk sieve, or still better by hand through muslin.

Argentine thus obained ought to be of a beautiful grey blue — when yellowish it is not so good, for it contains a little stannic oxide, which takes away part of the metallic brillancy, obtained by friction.

The printing is done in the following manner: dilute 320 to 380 grammes of argentine in one litre of solution of casein and ammonia, printing by hand or with a roller; slightly size the cloth and pass it through a friction calender.

Good results are not always obtained, for argentine is worked with difficulty. The roller has a tendency to become dirty and the doctors get coated with metal and do not then work cleanly.

To give the colour more consistency add a little size and pass through the English oxidizing machine.

CHAPTER III.

MACHINES AND APPARATUSES EMPLOYED IN FINISHING.

The thickenings or rather the sizes ought to undergo some preliminary operations before being applied to the cloth. — In the simplest case, for instance certain handkerchief and other styles imitating silk or satin, the fabric is soaked in rice-starch dissolved in cold water. This is an exception, for size generally contains bodies which only yield after having been submitted to the action of heat, either by boiling in open vessels or by boiling under pressure. We will examine the various apparatuses used by the small finisher as well as those used in large establishments.

Sometimes fabrics are finished without previously boiling the size, although the same may have for its base a thickening which ought to be boiled in order to work properly. This process, which we have seen carried out in Hungary, is now scarcely ever employed, and if we mention it, it is as a starting point and for historical information.

The size in question is made in the following manner. Water and starch are put into a dye vat. The pieces to be stiffened, are made to circulate in this bath, which is heated on a naked fire. The temperature rising causes the granules of starch gradually to swell and, at the end of a certain time, they stiffen the cloth; the water is run off

and the cloth dried in the air. As may be foreseen the results are irregular and very often the goods must be sized twice, and even then it is almost impossible to produce even, regular goods. Time and experience have proved that the starch must be first boiled, and then applied as evenly as possible to the fabric a result which can only be produced by machinery.

Apparatuses for boiling size. The simplest apparatus for boiling size consists of a wooden vat, at the bottom of which is placed a steam pipe, generally twisted. This manner of boiling is still often employed, but it has the serious inconvenience of producing too much condensation and of giving irregular pastes, either because they are too thin or because they are unequally boiled.

The following is a more practical apparatus. Into an oval or rectangular vat is introduced a steam pipe, to which is adapted an air injector. In this manner while the starch is boiling, it is put in motion by the bubbles of air, introduced by the injector, and the complete mixture of the ingredients is facilitated.

When it is a question of boiling starches etc. in which the liquid is already limited *a priori*, the double-bottomed trough is used fig. 1 or the double-bottomed boiler, heated by steam figs. 2 and 3 in which the volume of the mass cannot increase.

This latter exists in several forms, either fixed, when the preparation must be ladled out, or

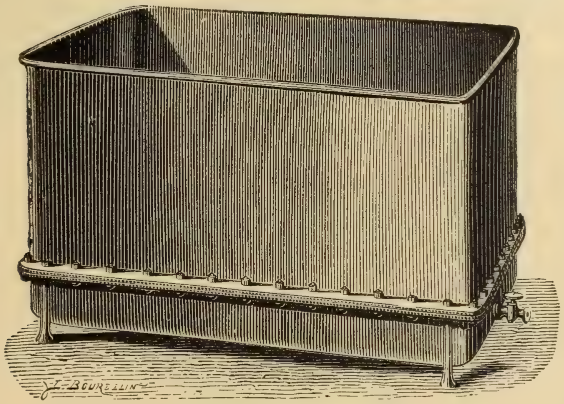


Fig. 1. Double-bottomed trough for boiling size, starch etc.

moveable when the size may be poured out by tilting the apparatus.

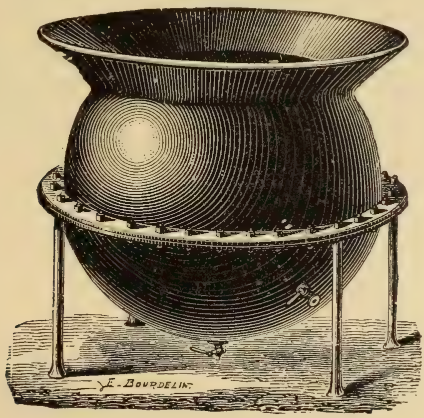


Fig. 2. Fixed double-cased pan heated by steam.

The steam enters by one of the trunnions, and the condensed water escapes by a tap placed at the bottom of the boiler.

Another system more usually employed and preferable in every way is the three-bottomed boiler fig. 4. It is composed, first of a metallic case, generally of copper, in which the mass is placed. This first case is separated from the second by a certain space, containing the steam, which boils the paste. The space between the second and third bottom is filled with a body

Fig. 3. Moveable double cased boiler (pan).

which must be a bad conductor, such as, bran, saw-dust, ashes, coke etc. to prevent the loss of heat and economize the steam.

The steam enters by the journals of the boiler, which can be tilted by a simple swivel arrangement in order to be easily emptied for cleaning purposes and for removing the cooked mass. The entrance of the steam, which takes place through one of the journals, is so arranged

as to allow steam or water to enter at will — the steam to boil the mass, the water to cool it, whilst a mechanical agitator, placed above the apparatus, constantly stirs it.

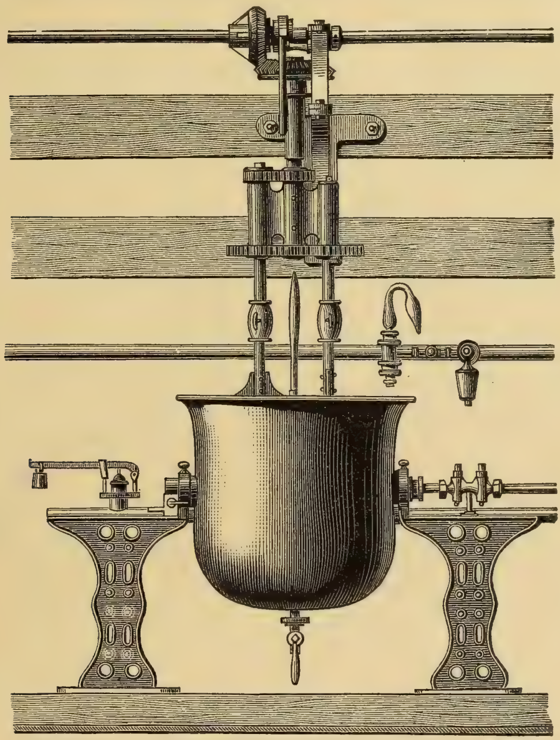


Fig. 4. Three-cased boiler.

It was formerly stirred by hand, afterwards a rotative apparatus was fitted to the boiler, which only partly agitated it and did not displace the mass in the middle of the boiler, lastly a double acting apparatus with eccentric spindle and varied speed was adopted, and this stirs all the parts

of the starch contained in the boiler, and consequently renders them homogeneous. This may be demonstrated by putting some water into a boiler, and then throwing in a handful of bran. In following attentively the movements of the particles of bran they will be seen to occupy successively every part of the boiler.

This apparatus is mostly adapted for very thick sizes, and for those which must be made with great care and exactitude.

The apparatus for boiling under pressure, called Simons apparatus, is especially employed for starches for printed goods, such pastes are not so thick, are more dissolved and less charged with earthy matters than the mixings for white goods.

It is composed of a closed cylindrical copper boiler, provided with six taps, one at the bottom for emptying purposes, one with a funnel in the middle of the dome for the introduction of the matter to be boiled, on one side of this tap is another tap for the inlet of steam, and on the other side one for the outlet of air; in the middle of the apparatus two taps are placed one above the other, which indicate the level of the liquid inside.

This apparatus is worked in the following manner:

1. Open the tap fixed at the end of the pipe, which commences on the dome of the appa-

ratus, and leave it open for the escape of cold air until the steam appears.

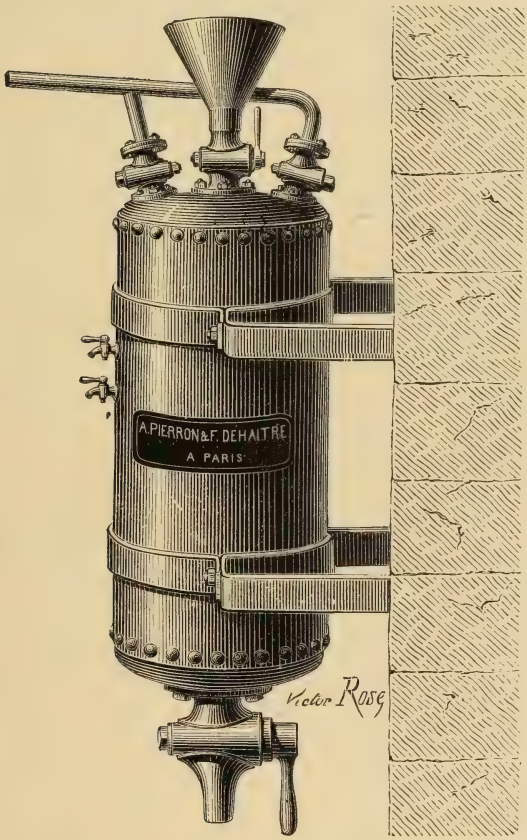


Fig. 5. Apparatus for boiling size under pressure.

2. Fill the apparatus with water, until it flows from the upper tap indicator, which, according to the capacity of the apparatus, marks 60, 80, 100 and 150 litres.

3. Open the steam tap gently in order to heat the water gradually. When it is hot enough to dilute the substances composing the size, reopen the upper tap indicator, and let the water run off until it descends to the level of the tap.

4. Close this tap and open the one for emptying in order to draw off into a special vessel the water used for diluting these substances.

5. Mix and thoroughly dilute for this is an essential point.

6. Gently open the steam tap, so that the diluted composition poured in at the same instant by the funnel, may not lodge in the bottom of the apparatus and thus obstruct the empyting tap.

7. Afterwards close the funnel tap, so that the size may not escape or boil over.

8. Open from time to time the blow off tap to let the air out, if by chance any remain.

9. Leave the steam from 5 to 10 minutes, in proportion to the pressure which exists in the boiler.

10. Gradually close the steam inlet tap, and take out the size by the tap at the bottom of the apparatus.

Prepare and have ready wooden vats to receive the size. Practical finishers then operate in different ways: some keep stirring it until completely cold, others, on the contrary, use it boiling hot.

In the chapter VI with recipes, we shall have occasion to refer to these various methods.

The same apparatus may also be used for the boiling of gum-tragacanth, but in this case it is slightly modified. The dome or hopper is constructed in such a manner as to be easily removed, in order to take out the gum-tragacanth mucilage which will not flow through the emptying tap.

Straining apparatuses. Boiled sizes etc. are nearly always full of lumps or of parts badly diffused in the mass. It is important to render the paste as homogeneous as possible. This is obtained by straining.

The simplest process is to employ a metal, hair or silk sieve, fine or coarse, according to the mass to be strained. The paste is strained by means of a brush, which causes it to pass through the meshes of the sieve. This system was perfected in 1850 by causing the brush to work mechanically on the fixed sieve.

Mr. *Dolfus* has constructed (1882) a very ingenious apparatus, in which the brush works in the same way as the hand. It does not describe a circle, but a series of curves, representing the action of sifting by hand. The straining is facilitated by a circular motion given to the sieve in the direction contrary to that of the brush.

Another method much in use, but which is more expensive than the preceding machine, inasmuch as it requires two workmen and gives smaller results, consists in squeezing the size through linen or cotton bags. These bags, which are

funnel-shaped, are filled with the sizing matter. The workmen then take two round sticks at top

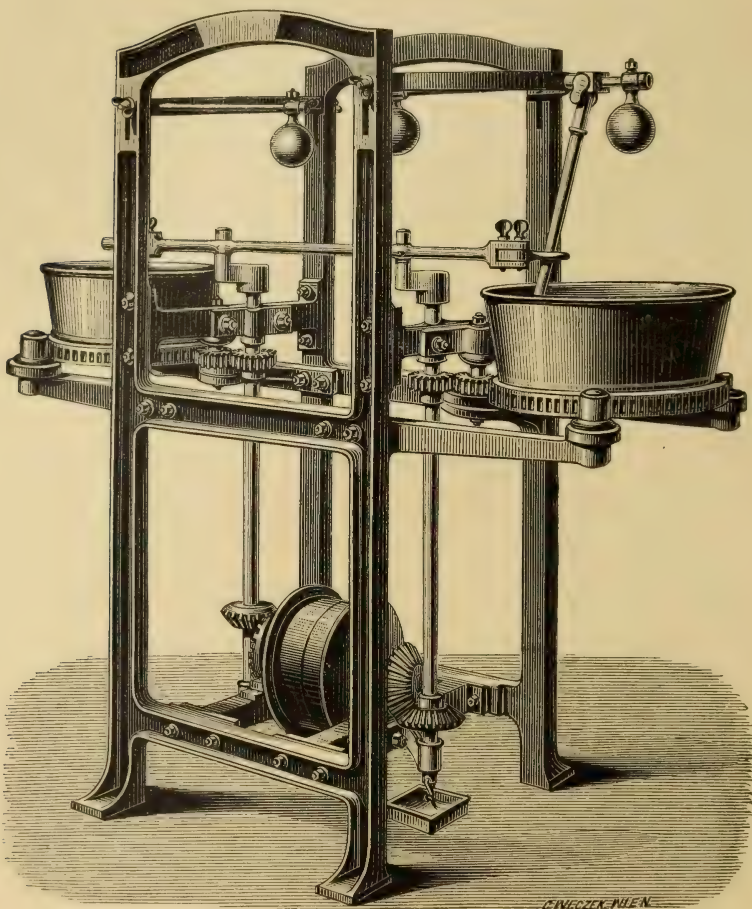


Fig. 6. Colour straynings machine.

of sack and pressing them with great force against each other, push them down the bag lengthways. The size is thus squeezed through, but

the cloth is often torn, and as already mentioned this process is very expensive and slow. An apparatus, made on the same principle, is much used in England.

This machine consists of a frame, formed of two uprights and a transverse piece, connecting them at the top. Inside and midway between these two uprights two cylinders are fitted, varying from ten to twenty centimetres in diameter and which can be moved nearer to or further from each other. In the middle of the transverse piece a screw is fixed with a hand-pulley attached to raise or lower it; and at the end of this screw a pointed bag is fastened, containing the size to be strained. When the screw is at the lowest point of its course the two rollers are brought near the bag, the screw is then raised, and the paste is thus squeezed out by the two rollers.

Another system consists in the employment of a cylinder in which a piston works. To the lower part of the cylinder a sieve is attached fixed by a bayonet movement. The sizing matter being placed in the cylinder, the piston, worked by means of a rack, closes the cylinder hermetically over the paste which is thus pressed through the sieve.

Another system, due to Ridge, consists in utilizing the action of a hydraulic press. A reservoir, with a movable sieve in the bottom, is filled with the size to be strained: the piston of the press

strikes against this sieve and the reservoir is provided with a tight fitting cover. Below the apparatus is an inclined plane then by the action of the press, working up and down, the sizing matter is forced through the sieve, and falls on the inclined plane, whence it flows into a tub, placed to receive it.

Lastly there is the apparatus for straining by vacuum. The principal parts are: A reservoir, provided with a funnel, at the bottom of which is a sieve; an aspirator which can be connected with the condenser of the steam engine or with a steam pipe, which heats it to a certain degree, The steam is afterwards condensed by jets of cold water. We will give to this part of the apparatus the special name of »condenser«. It is made of rivetted sheet-iron, is capable of containing about 300 littres, and has four taps placed one above the other at the side. The first and highest, supplies cold water which flows through a perforated pipe and which traverses the »condenser« horizontally; the second tap supplies steam; the third communicates with the aspirator to cause a vacuum beneath the sieve; the fourth is a blow-off tap, the orifice or aperture of which must correspond with a pipe at least 20 millimetres in diameter. The condenser is also provided with a vacuum gauge.

The *aspirator* consists of a cast-iron shell or cover, 0·65 m. in diameter by 0·50 m. in depth,

to contain an empty vat of 60 litres capacity. The brim of this shell or cover is provided with a deep groove with a band of vulcanized india-rubber. Round the lid and surmounted by the hopper and sieves, is a projection, which fits exactly into the groove of the shell. The copper hopper fitted to the lid is 0 m. 22 high, 0 m. 52 in diameter at the top and 0 m 30 in diameter at the bottom. It is provided at the bottom with a strong wire gauze, with large meshes to support the fine sieve. The latter is tightly stretched on a movable copper ring and can be changed according to requirement. Above the sieve is a second movable copper ring with a gauze of larger meshes; these two sieves prepare the paste to pass more easily through the fine sieve by separating and breaking up the lumps and bits of skins which it may contain. The rings, to which the wire gauze or sieves are fixed contain in the lower part and on the outer side a deep groove serving to secure the sieve by means of a tightly fastened brass wire.

At the side of the aspirator is an arrangement for washing the hopper and the sieves. Above a stone tank, some pieces of wood, of the same height as, and parallel to, each other, are fixed in the wall to hold the lid with the hopper. A little above this is the water-tap, provided with an india-rubber pipe which guides the jet of water.

To work this machine the empty vat is placed in the aspirator and the lid carefully fitted into

the groove of the shell. The weight of the lid pressing on the india-rubber band forms a joint which closes hermetically. To obtain this result precautions must be taken or the working of the machine may be impeded.

The projection or rim, as well as the groove with the india-rubber band, should be thoroughly washed, but it is essential that they be well dried afterwards, and especially the groove, so as to completely remove the water, which would prevent them closing hermetically. Care also must be taken to remove any sand brought by the water used in washing, as a single grain of sand causes a bad joint, and in this case enough air would pass in a short time to fill the aspirator without a drop of colour being strained. When the colour is poured into the hopper the vacuum necessary for the sifting must be obtained.

All the taps being closed, the blow-off tap is first opened and then the steam tap. The water in the condenser is expelled; the steam-tap is instantly closed and the blow-off tap is left open until the expansion of the steam is completed, that is to say, until it emerges but in small quantities from the blow-off pipe. This precaution is essential. It is then closed and the large cold water-tap is opened — the tap of the vacuum gauge always remaining open.

For four or five seconds no reaction is seen, but after this time the vacuum forms rapidly, and

in the space of a few minutes the needle of the gauge rises to 600 and even 700 millimetres. The water-tap is immediately closed and the tap connected with the aspirator opened. It is opened wide when very thick colours or starches have to pass and half opened for thin ones. In this manner the colour or starch runs slowly enough to give the workman time to pour it continuously into the hopper until the vat is full.

With a condenser of 300 litres capacity, from 120 to 130 litres of thin or starch size may be strained by dividing the operation; but only from 60 to 80 litres of thick size. This is because the thick size requires 40 centimetres of vacuum for its suction, whilst the thin size passes through with only 10 centimetres.

These operations may follow each other rapidly for instance at from *5 to 6 minutes interval*, for 60 litres of paste, each litre containing from 150 to 170 grammes of starch.

These different systems include all the straining machines employed now-a-days.

ON DIFFERENT METHODS OF APPLYING SIZE OR STARCH TO CLOTH.

The size having been prepared, must now be applied to the cloth. According to the results required, it is applied on one or both sides; several means of application entirely differing from one another have been contrived for this purpose, and we propose to give some details of each.

These different methods may be reduced to three distinct classes.

1stly. By *padding.* The piece passes full width through the starch trough where, it is more or less impregnated on both sides. The results are very varied, according to the thickness of the size, the pressure given to the *bowls* the number of them, and their diameter. — With a very thin size and small »*bowls*« worked under strong pressure, very little will remain in the cloth; if on the contrary a very thick size is used and it is padded on large padding rollers, with little pressure, the cloth will be largely impregnated.

2ndly. By *printing.* The piece receives the starch on one side, by means of an engraved roller, provided with a doctor, and with a certain pressure. — In this case the strength of the stiffness depends on the depth of the engraving and the pressure given to the roller; the kind of engraving

also plays an important part. It is also very important to employ the »*pin*« style of engraving, — engraving by *single slash lines* tending with thin size to give the cloth more stiffening on one side than the other, on account of the disposition of the slashing which forms a helical line round the roller. This style of engraving has more over the drawback of soon becoming dirty, and of wearing out in the direction of the working of the apparatus.

The style of engraving with *cross-over slash lines* gives fairly good results, preferable to those by single slash lines, but not so good as the »*pin*« style.

The strength of the stiffening depends also on the pressure given to the roller. The squeezing roller, on which the printing is done ought to be furnished with a lapping or blanket. With the same pressure acting on the padding roller, the size will penetrate the cloth more thoroughly, if the blanket is very firm and will be more superficially applied to the cloth if the blanket is flexible or gives.

The depth of the engraving also modifies the finish. — The deeper and farther apart it is, the stiffer will be the finish whilst with a very light engraving and very close »*pins*«, an almost imperceptible coating of starch may be given. If then a very coarsely engraved roller is taken with a hard blanket, and with strong pressure the finish will be stiff and the thickening will almost complete-

ly penetrate the cloth, whilst with a roller more finely engraved, a very soft blanket and weak pressure, the cloth will be very lightly starched and only on the surface.

3rdly. *By friction.* This last mode, much employed at the present time, and giving excellent results, may be regarded as a kind of continuous painting. In fact, with ordinary painting, the colour is rubbed with a brush on a stretched canvas; instead of taking a brush let us imagine a case of the width of the cloth and filled not with colour, but with thickening material. If the case placed above the cloth is provided at the bottom with a transversal slit, the size will run out on to the cloth but it will be necessary to move the latter in a given direction, so that the size may be equally spread over the whole surface of the cloth, and even then it will only be applied in irregular layers. If a doctor or even two are applied to the cloth, after it has been impregnated, they will take off the excess of size and will give a regular stiffening, applied only to one side of the fabric.

This method (Pl. IV. Fig. 19) which has been in use for the last fifteen years, has been modified in the following manner. The parts have been reversed: the cloth is passed over a roller immersed in the size. — The excess of size is taken off by a doctor, then by means of a mechanism that we will study in detail later on, the friction

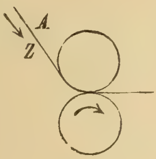


Fig. 1.

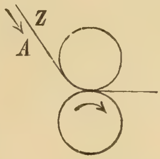


Fig. 2.

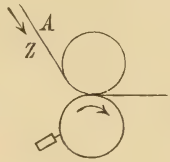


Fig. 3.

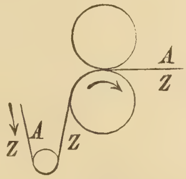


Fig. 4.

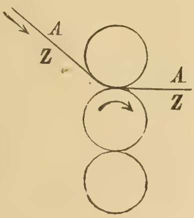


Fig. 5.

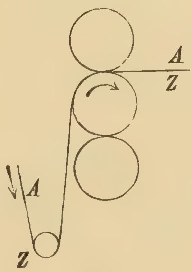


Fig. 6.

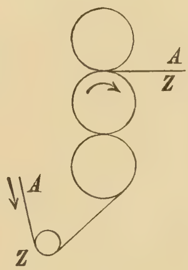


Fig. 7.

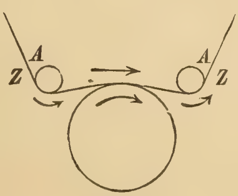


Fig. 8.

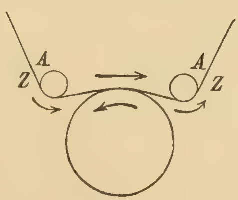


Fig. 9.

Pl. III.

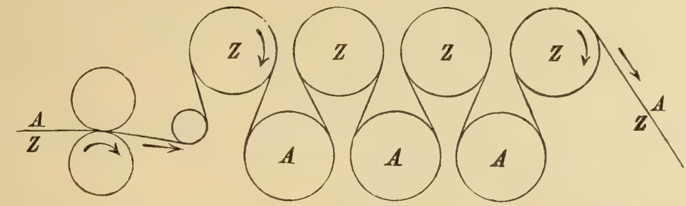


Fig. 10.

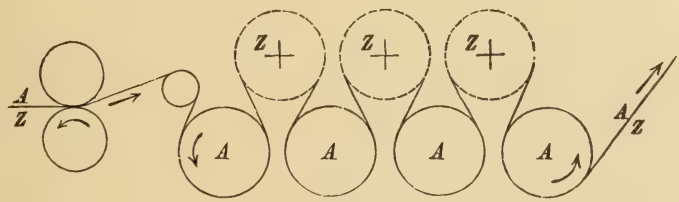


Fig. 11.

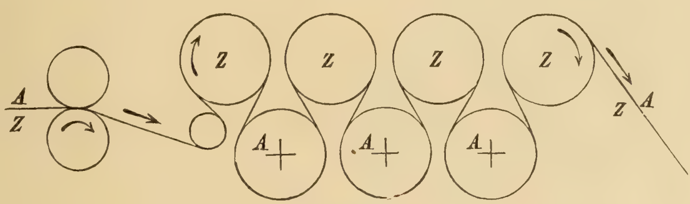


Fig. 12.

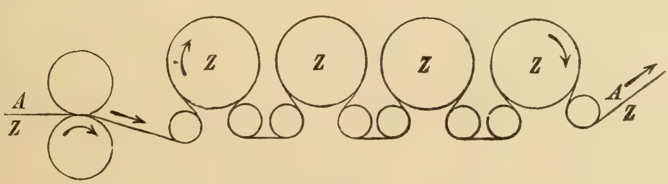


Fig. 13.

of the stuff against the size roller may be diminished or increased.

The roller may be engraved or plain, working with or without a doctor, and turning either in the direction of the piece or in the opposite way. It may as we have already said, touch the piece very lightly or rub strongly against it.

There is still another method called immersion, of which we have already spoken, but which is not practicable. It is an application on a large scale of the method employed by laundresses for starching linen. (See page 69.)

In the following diagrams we will examine the various ways of operating in the application of these different methods of starching.

Pl. II. Fig. 1. The stuff passes between two wooden, metal or india-rubber rollers (1).

[We do not here enter into the details of the operation, we only mention the manner of

(1) For some time past metallic rollers, covered with india-rubber have been used. — These kinds of rollers render immense services. There is an economy of time, as it is not necessary for each operation to change, the blanket or lapping; an economy of cloth, the use of blankets being suppressed, and there is also a perfect regularity of movement. The india-rubber has also the advantage of not being attacked by the materials employed, — except by fatty matters- and it bears temperatures varying from + 20° to + 80° *C.*, without undergoing any change. — The price of these rollers is relatively moderate considering the great expense caused by blankets and back-greys, loss of time etc. — The rollers may be covered with cloth, blankets, lapping, back-grey etc.

application, used for each of the classes we have just examined.]

The top roller presses on the lower one which is immersed in the size. The machine sometimes admits of three rollers (Pl. II. Fig. 5), the bottom roller working as the size-roller or also as the squeezing roller.

In these diagrams we shall indicate by the letters A and Z the cloth to be finished. A specifies the face, and Z the back of cloth. The direction of the movement of the fabric and of the machines is indicated by arrows.

Pl. II. Fig. 2. Same disposition but the cloth receives the starch on the back without a furnishing roller. In such cases, it penetrates the cloth, being squeezed through by the rollers.

Pl. II. Fig. 3. The bottom roller is engraved and provided with a doctor. The top roller is provided with a lapping, sometimes also with a back-grey to prevent the sticking of the starch to the selvages of the cloth. The cloth passes with the back Z underneath. As we have remarked, under these conditions the starch does not penetrate but remains deposited on the surface of the cloth.

Pl. II. Fig. 4. The cloth passes first into a trough containing the thickening and is in consequence evenly impregnated with the size, the rollers squeezing out the superfluous size. These rollers can be regulated and by different degrees of

pressure more or less paste can be applied to the fabric.

Pl. II. Fig. 5. This diagram represents a 3 bowl mangle. The result obtained is almost similar to that in the method shewn by fig. 1. pl. II.

The pressure and composition of the size play an important part.

In this combination, the squeezing rollers are sometimes furnished with wheels and gear for producing friction on the cloth. This method is especially employed when the fabric is to be finished on both sides, and the size is required to penetrate the pores of the cloth equally. This method is used in several cases, which we have yet to examine.

Pl. II. Fig. 6. Method of working similar to that indicated in fig. 2 with the exception, that here the cloth is first impregnated in the starch and afterwards squeezed between two squeezing rollers, whilst in the method shewn by fig. 2. Pl. II. the cloth only receives the size from the bottom roller.

In this case the cloth is more impregnated with size than in the method shewn by fig. 5. Pl. II.

Pl. II. Fig. 7. Gives a result analogous to the method indicated by Pl. II. Fig. 4, but here the cloth is filled much more, in consequence of the increased contact which takes place *twice*

between *two rollers*, whilst in the method shewn fig. 4 contact only takes place *once* on *two rollers*.

Pl. II. Fig. 8. The cloth passes on the reverse side Z. with friction on an engraved or plain roller, which, in either case, may be provided with a doctor and which turns in the direction of the cloth, the speed of the roller being nearly three times as great as that of the cloth. This method constitutes the first trial of this idea; it has since been recognized, that to turn the engraved roller in the reverse way to the motion of the piece is much better.

Pl. II. Fig. 9. The cloth passes on the reverse side Z.; rubbing against an engraved roller, and turning in the opposite direction to that of the cloth. According to the result desired, the face or back of the cloth is treated. Our figure represents the back of cloth.

The different treatments, which follow, refer to the manner of drying, which has a great influence on the stiffening, as well as to the application of the starch.

Pl. III. Fig. 10. This method and the three following ones, relate more especially to drying on cylinders. In this case and in the following from Pl. III. Fig. 10 to Pl. III. Fig 13 we will deal with the starch applied to the back of the cloth.

(It is evident that another method of stiffening would modify the mode of drying. Whether the

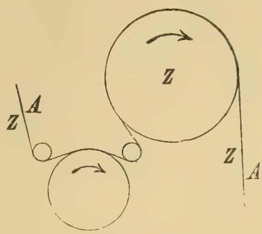


Fig. 14.

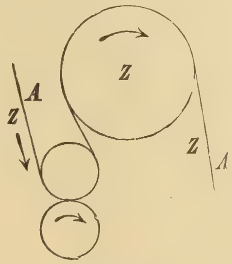


Fig. 15.

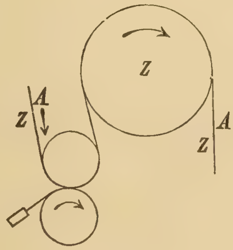


Fig. 16.

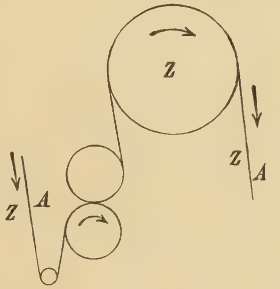


Fig. 17.

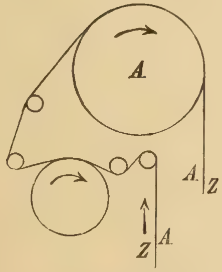


Fig. 18.

Fig. 19.

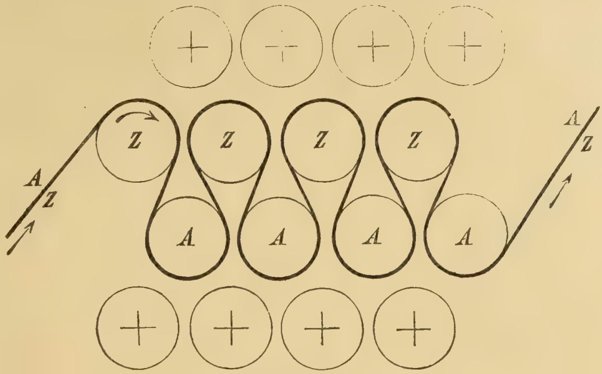


Fig. 20.

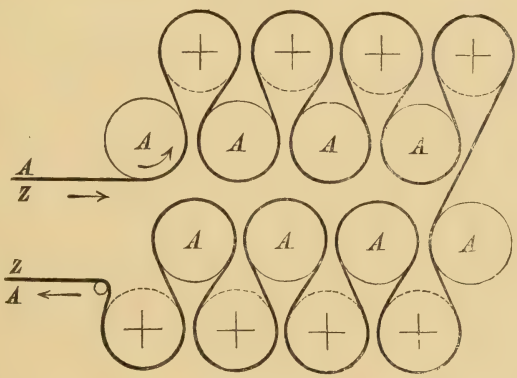


Fig. 21.

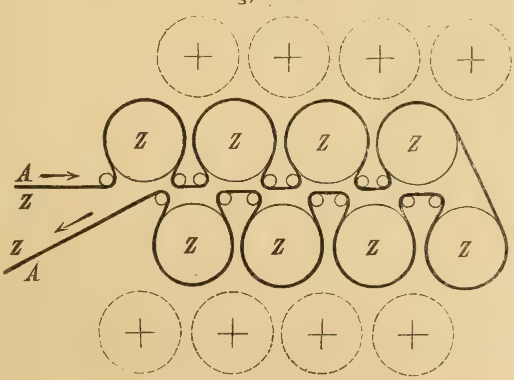


Fig. 22.

goods be starched on the one side only or on both sides, with or without friction, or in whichever manner the starch be applied to the cloth, it will certainly be included in one of the before mentioned methods).

The stiffened cloth passes over a series of drying drums, also called cylinders — in this case the right side A. and the back Z., touch the metal.

Pl. III. Fig. 11. The same passage through the starch, but here the cloth touches the drums only on the face A. — the back passes over winces or wood lagged drums.

Pl. III. Fig. 12. Again the same passage as in Fig. 10, Pl. III, but here the cloth is only in contact on the back Z. The face A. does not actually touch the heated metallic parts, being only in contact with the winces.

Pl. III. Fig. 13. The cloth passes between the rollers as in Fig. 1. Pl. II; it is dried on a machine without winces, so that only the back Z. comes in contact with the heated metal, as the piece glides over the small unheated guide rollers

Pl. IV. Fig. 14. Passage through the friction apparatus as in Fig. 8. Pl. II with doctor then drying with the back Z., on a large single drum, the face being visible on the stenter.

Pl. IV. Fig. 15. This disposition and the four following ones specially represent the course of the cloth and the mode of drying by the stenter with cylinders.

Passage through mangle as in Fig. 1. Pl. II. drying the cloth on the back over the single drum, face being visible on the stenter.

Pl. IV. Fig. 16. Passage through mangle with doctor, as in Fig. 3. Pl. II. Drying as in Fig. 14. Pl. IV. that is to say, the back on the single drum, face of cloth being visible on stenter.

Pl. IV. Fig. 17. Passage through an open trough as in Pl. II. Fig. 4 drying on the single drum, with the back, on the drum — the face visible on the stenter.

Pl. IV. Fig. 18. Passage in the friction apparatus in Fig. 8. Pl. II. with doctor, then drying with the right side on the single drum. The back visible on the stenter.

These various methods include all the methods available for starching and drying cloth mechanically.

We will now examine the improvements which have been made in drying machines, and which allow either both sides at once, or the face, or the reverse side, to be dried on the same machine — whether the cloth be starched in an open trough, or on one of the sides, in short, whatever may be the means employed for the application of the thickening material.

Under ordinary conditions a drying machine is composed of a series of cylinders ranging from 1 to 17 or even 19 in number, they are generally placed so as to alternate, that is to say, that

below the first two cylindres, placed in a straight line, there is a third cylinder which forms an equilateral triangle, with the preceding ones and which constitutes the commencement of the lower series.

These cylinders can be placed horizontally (in a line) or vertically (upright). This last disposition is preferable in certain cases, especially when the space is limited. We shall have an opportunity later on of referring to the construction of these machines in the two different ways.

Now, if we continue placing the cylinders in the same order, and the cloth be passed over them, it will touch alternately the top and bottom cylinders, and will dry by the contact of the surface and reverse side. Pl. V. Fig. 20.

But if a series of winces, or woodlagged cylinders be placed in the same manner at the top and bottom, the cloth will have, with the same mode of entrance, contact only on the surface, by admitting the reverse or starched side below. Pl. V. Fig. 21.

Again if we place a series of small rollers below the top cylinders and over the bottom cylinders, we shall obtain by the entrance of the cloth with surface upwards and reverse and starched side downwards contact only on the surface. Pl. V. Fig. 22.

We can therefore with this machine alone realise all the possible forms of drying by mechanical means.

This kind of arrangement is much employed to-day, especially when it is a question of a drying cylinder for several purposes.

It enables one to starch on the reverse side and to dry the right side, which is very advantageous for the finish as well as for the colours; the size penetrates less, dries better and does not tarnish the colours even when the printed side is in contact.

SPECIAL MACHINES EMPLOYED FOR STIFFENING COTTON FABRICS.

The simplest apparatus, the padding machine, consists of a frame carrying two rollers; the bottom one is generally of iron or copper, covered with flannel or soft material or india-rubber; the top one of metal or wood; sometimes these two rollers are both of wood. They can be of dimensions, varying from 15 to 40 centimetres in diameter; underneath them is a large basin or trough, provided with one or several small rollers for the passing of the cloth through the open bath, or simply a frame without any accessories into which the bottom roller dips; or a frame with starch furnishing roller as in printing machines.

The starch trough can, by means of a toothed rack, be raised or lowered at will according to the supply to be given.

The piece rolled up is placed at the entrance, it passes over a scrimp ruil contrivance to take out the creases, and at the exit end isa batching apparatus for rolling up the starched cloth. (Fig. 7, p. 95.)

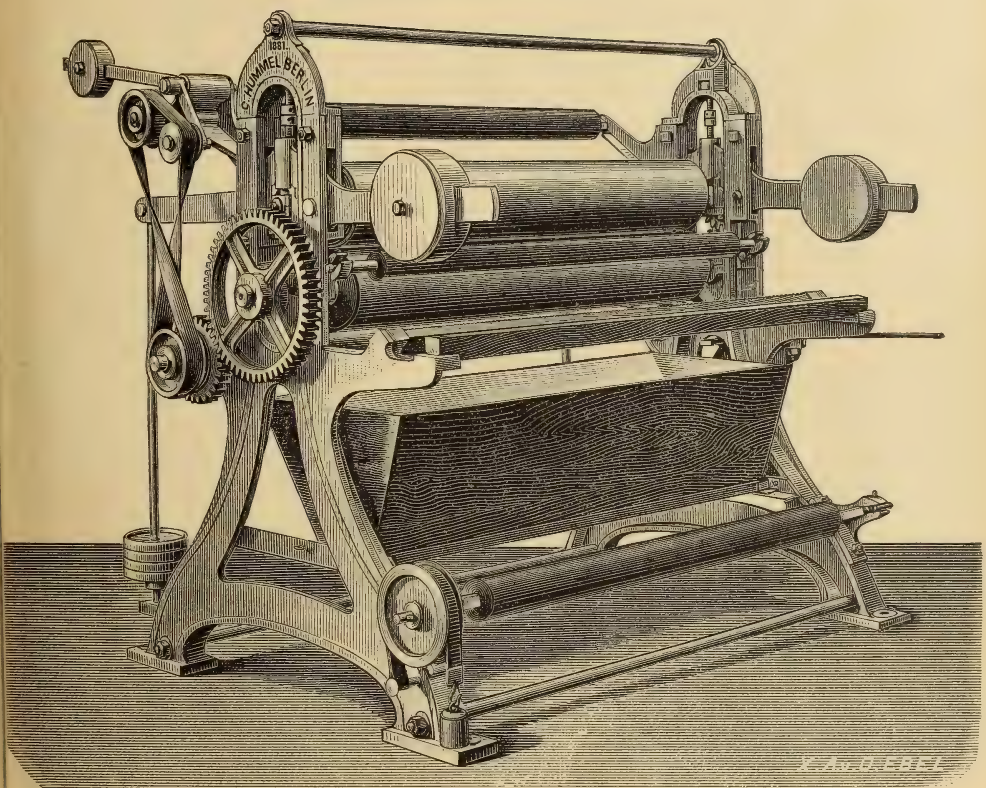


Fig. 7. Simple starch Mangle.

If, the piece is wanled plaited down a girl should be stationed behind the machine to fold it as it comes out.

This apparatus, which in our drawing is driven by a strap, may be worked by special motor it is also provided with a set of levers, weighted so as to increase the pressure. It serves for white as well as for plain or printed goods.

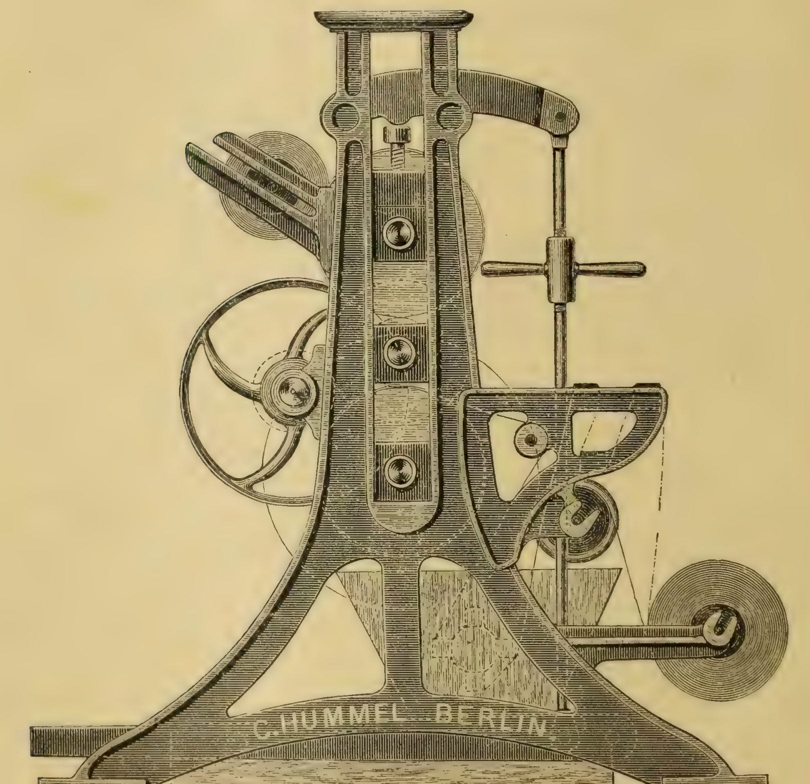


Fig. 8. Starch Mangle with three bowls and spreading roller.

Another apparatus (fig. 8, p. 96) is a starching machine with three bowls, which is specially employed for heavily starched white or dyed goods

It is composed of a wooden or cast-iron frame, in which three bowls are placed. In our plate the middle bowl is of metal (copper or steel) but it may also be of wood. Underneath is the starch trough; above and behind the third roller is an automatic batching apparatus.

In front of the machine is a stretching apparatus for removing any creases there may be in the cloth. The pressure is given by means of a screw-lever, which regulates it, and if necessary another screw may be added, and placed on the journal of the third and top-most roller. The bottom roller bears all the pressure, and the middle one is under the direct influence of the top roller. This apparatus works with or without the friction wheel: generally without.

The machine (fig. 9, page 98) is driven direct by steam engine and can consequently be worked at different speeds which cannot be obtained with the other machines although they are constructed on the same principle. The only difference being, that in this machine the middle roller is fixed and the pressure can be varied: 1^{stly} by giving the pressure from below, by means of levers acting on the bottom roller: 2^{ndly} by giving the pressure with the screws acting on the top roller: 3^{rdly} by causing the two pressures to act simultaneously. This machine is also provided with gearing, fitted to the middle roller and which allows it to

be worked by friction. These mangles are modified by sometimes placing the metal roller at the lower part of the machine, near the bottom of the trough. The friction takes place between the two wooden bowls; the bottom

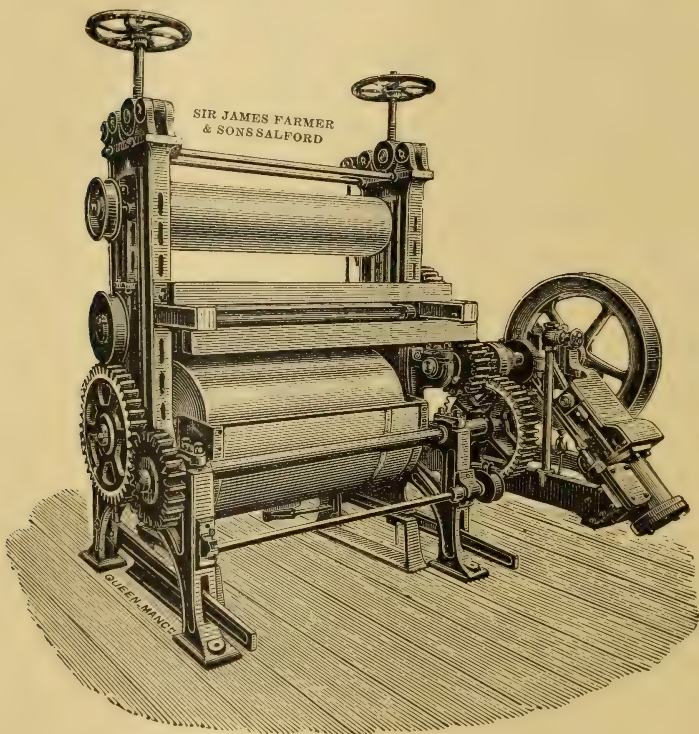


Fig. 9. Sizing machine with three rollers, double pressure, and driven by steam.

bowl of copper or metal is intended to prepare for the penetration of the paste into the cloth, and to thoroughly impregnate the latter with it.

The special mangles for stiffening white goods are almost always by friction, so that the

pastes (generally weighted) penetrate the cloth more thoroughly.

Starching machines are sometimes independent of the drying apparatuses so that, according to circumstances, the cloth can be starched by machinery and then dried in a drying-room or on cylinders; but as it is generally a question of quantities, the starch mangle is invariably combined with a drying machine. These combinations are illustrated in the figures 11, 12, 13, 16.

The different kinds of machines we have just reveiwed are especially used for double-faced starching, that is to say, where the paste may be applied on either side; therefore they are chiefly utilized for white and plain goods. Such a machine under favorable conditions can starch or stiffen from 1500 to 2000 metres of cloth an hour with one width of cloth.

In the finishing of printed calicoes or of certain special styles, which only require to be starched on one side, the machine fig. 10, page 100, is used. It is composed of a frame with an engraved pin roller, above this roller a doctor is adjusted for removing the excess of starch, so that an equal quantity may always be applied to the cloth. Above the engraved roller is placed another roller which may be in india-rubber or covered with lapping or still better with en endless lapping giving an elasticity as in a printing machine. It works by friction and carries

along the piece, which should never be batched, but folded and then dried on a cylinder. Below these two rollers is the starch-trough. If a piece,

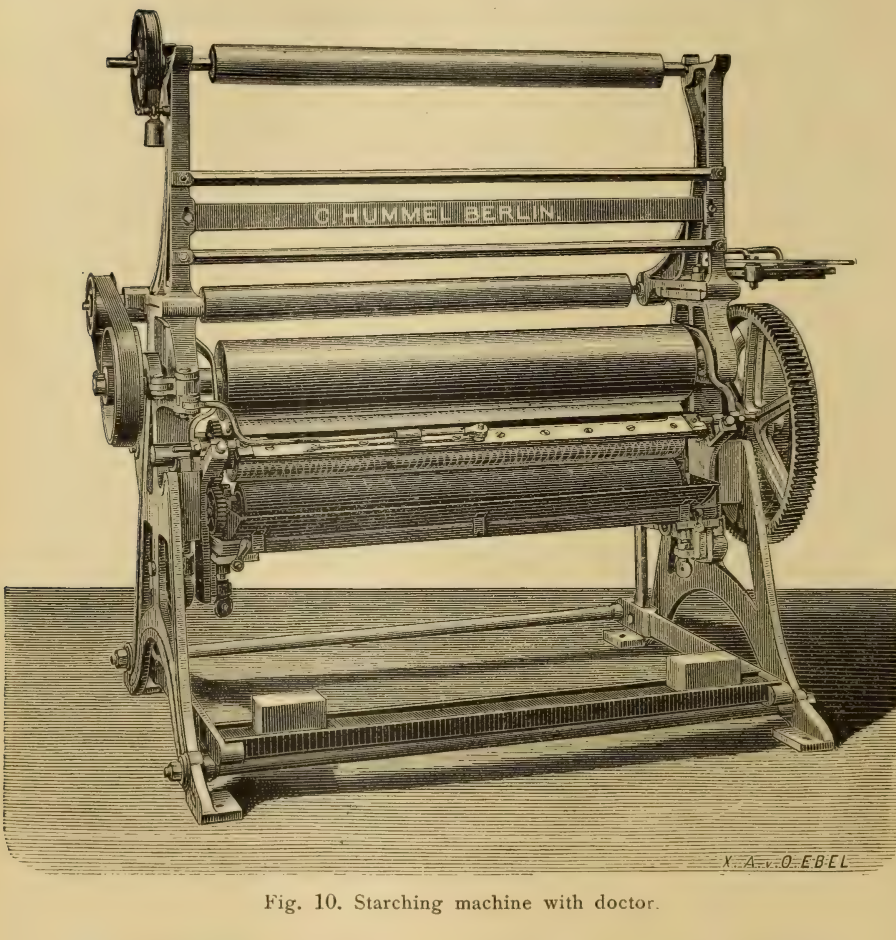


Fig. 10. Starching machine with doctor.

starched on this mangle, be rolled up, it will stick or the size will soak through, and the object aimed at be lost for this machine serves chiefly for delicate styles, which require immediate drying. This appa-

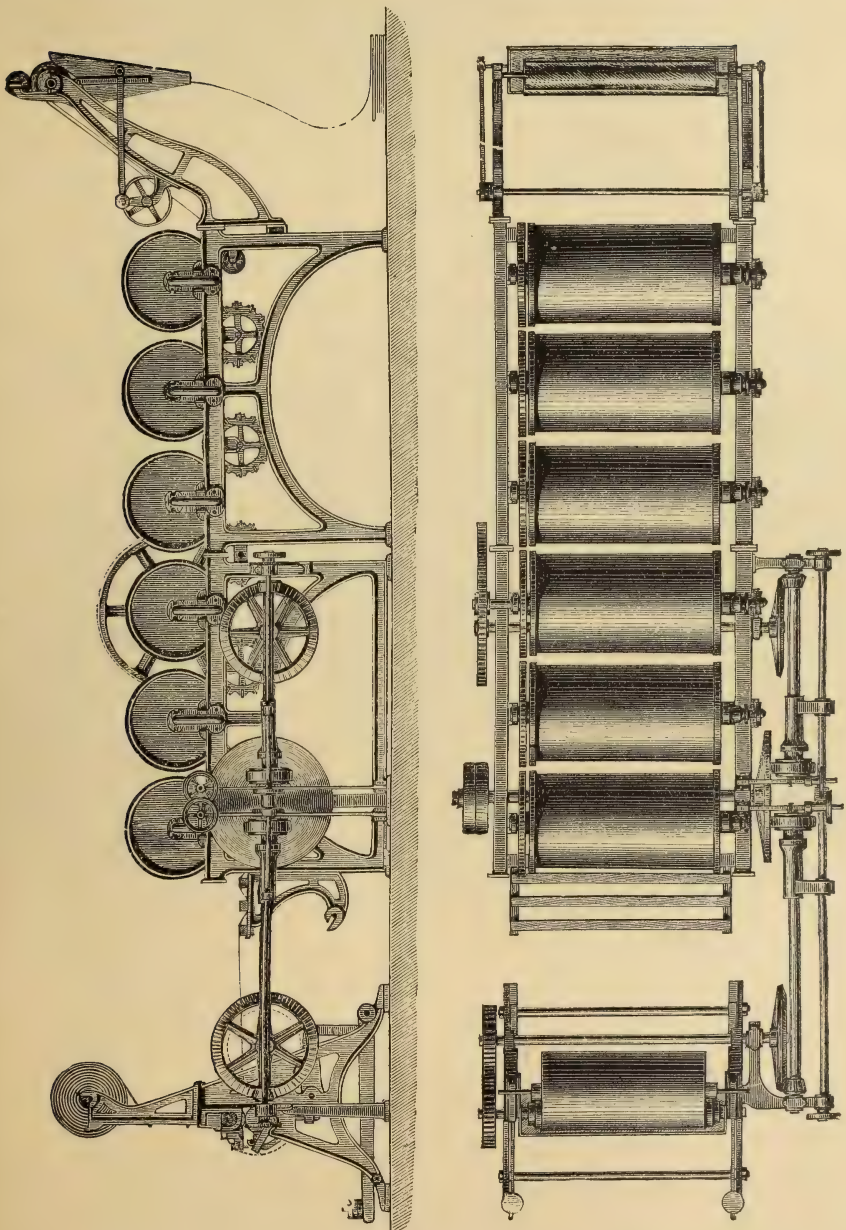


Fig. 11. Starching machine with doctor combined with six drying cylinders, drying on the reverse side.

ratus is therefore generally combined with a cylinder drying machine, because it dries the starch rapidly and is so arranged that the starched side of the cloth comes in direct contact with the drying cylinders (fig. 11, page 101).

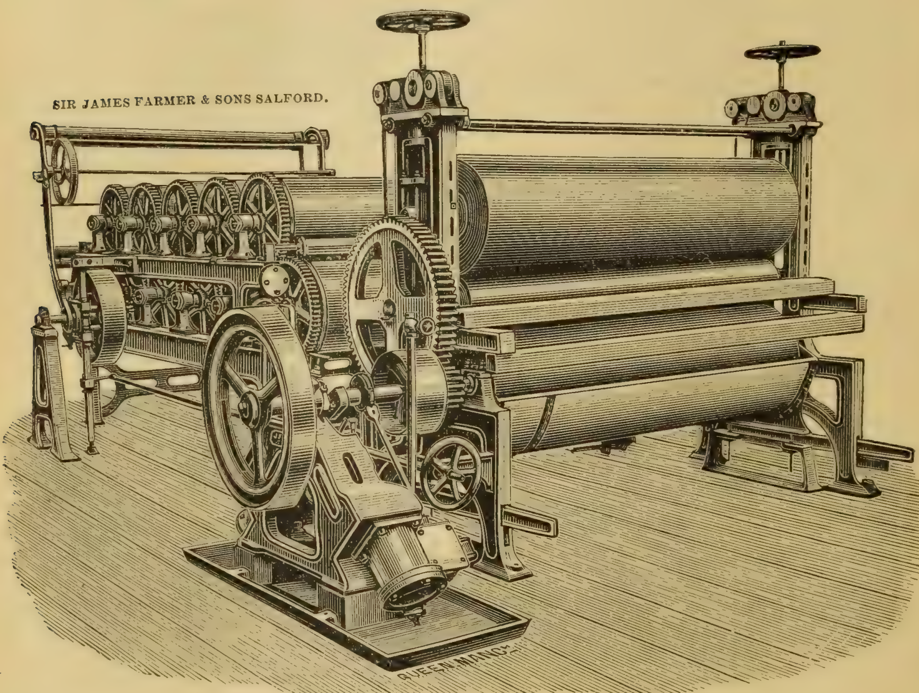


Fig. 12. Combined friction starch mangle and eleven cylinder drying machine.

We shall not again refer to the methods of drying, we only give a few drawings representing the combinations most generally in use.

Figure 12, page 102, represents a combined friction starch mangle and drying machine (eleven cylinders with contact on both sides of cloth).

This machine is driven by a small steam engine, and is fitted up with a simple padding-machine as represented in fig. 11, page 101; it is used for chloring and blueing of printed cloths, and we mention it here specially on account of this combination, as it thus renders great services for printed goods. It is important that the chlorine should act energetically as soon as it is placed on the cloth. The best method, when there are no impurities on either surface of the cloth, is that already mentioned, for by the deposit of chlorine on the cloth, when, for instance, a doctor is used, it must be noted that only the non printed tissue takes the chlorine, whilst the printed parts resist and are not so easily attacked because they absorb smaller quantities of the chlorine bath. (See Chloring and Blueing.)

These apparatuses are combined, so as to be utilized for chloring as well as blueing and starching. The apparatus fig. 13, page 104, represents a double width padding-machine, which can be utilized for starching as well as for chloring and blueing on one side. We shall see in the chapter on drying machines the relative influence of the number of cylinders and the comparative drying power of different diameters of cylinders.

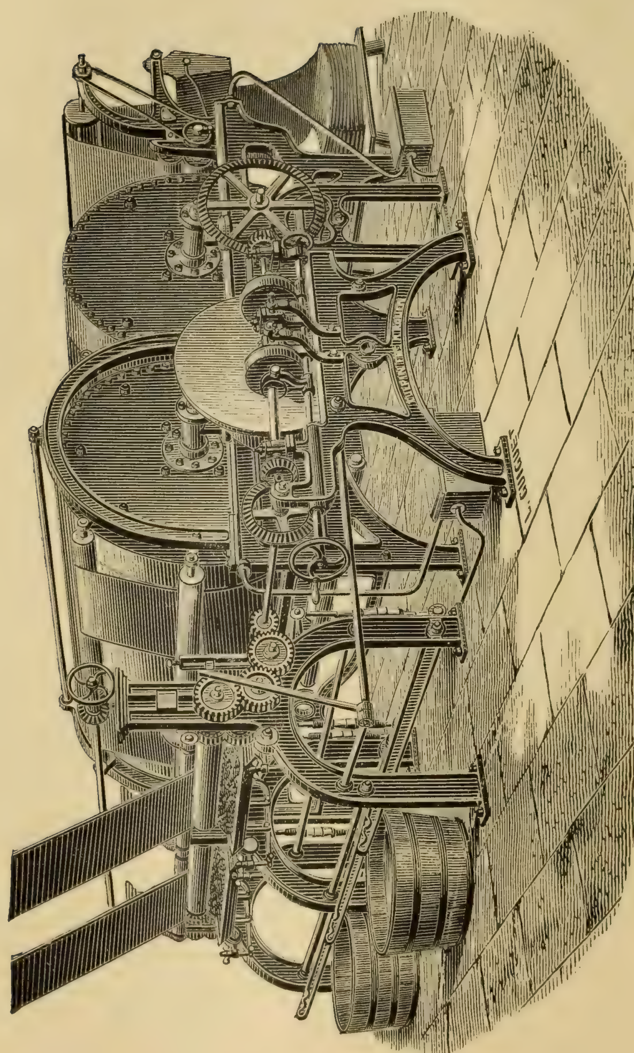


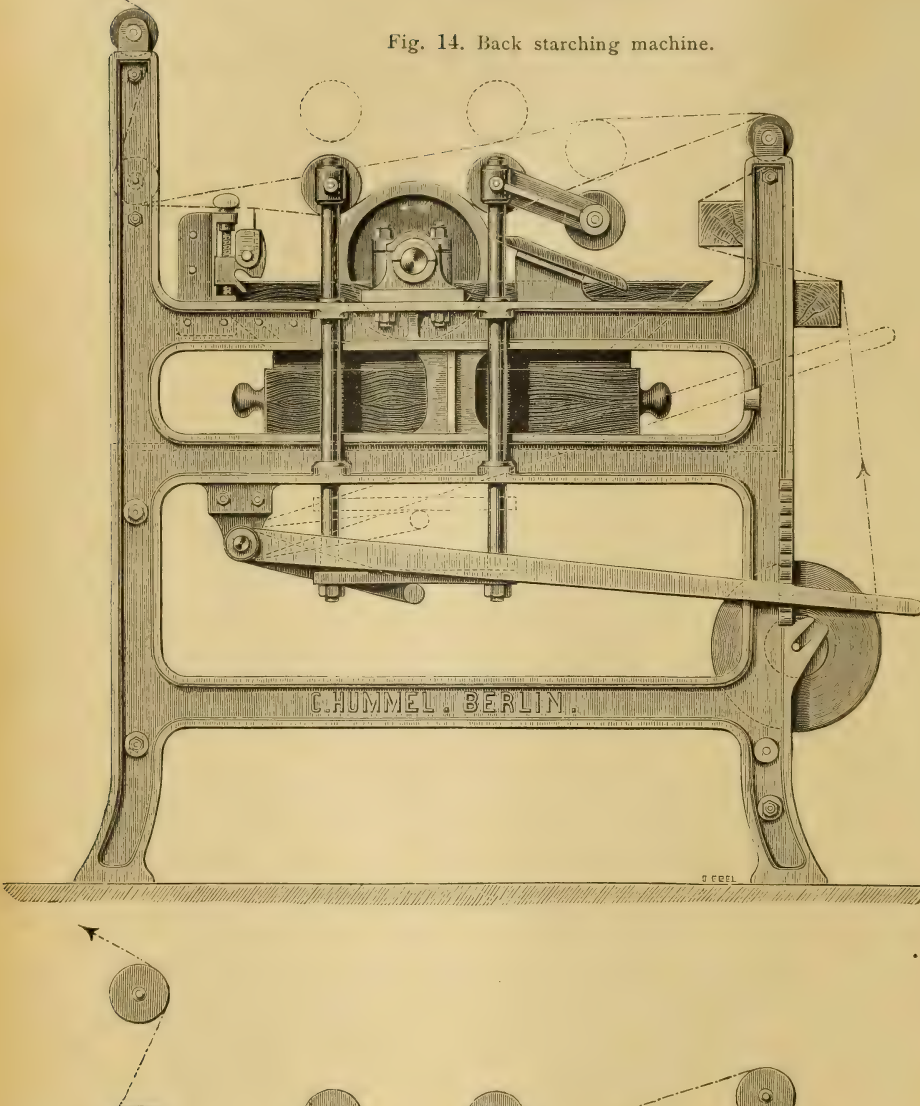
Fig. 13. Combined double width starch mangle and two large cylinder drying machine.

The apparatuses so far examined, stiffen on both sides or on one side *under certain conditions only.* The following machines, unquestionably the most perfect that exist at the present time, work equally well whatever the nature of the starch or paste may be, and enable the finisher to put large quantities of solid or »filling« matters into the cloth. We have already described the principle of these apparatuses, pages 88 and 89.

Fig. 14, page 106 represents the section in elevation of a back starching machine, by friction. Fig. 15, pag. 106, gives the diagram of it. The arrangement of the apparatus may be easily understood after a simple inspection of the figures. It consists of an engraved or a plain roller, furnished with a doctor; above this roller at the sides two movable rollers, that is to say, rollers that can be raised or lowered; — the cloth may enter rolled up as in fig. 14, pag. 106, or a special arrangement is made which admits of the piece being starched without being batched. It enters in loose folds and in front of the machine sufficient space is left to enable the workman to guide it. An opening apparatus stretches the cloth according to its quality and the amount of stiffening or friction to be given to it.

Fig. 16, page 107, represents in perspective a complete starch range. It is composed of an ordinary mangle (for starching both sides) placed in front, and in such a manner, that in need, it

Fig. 14. Back starching machine.



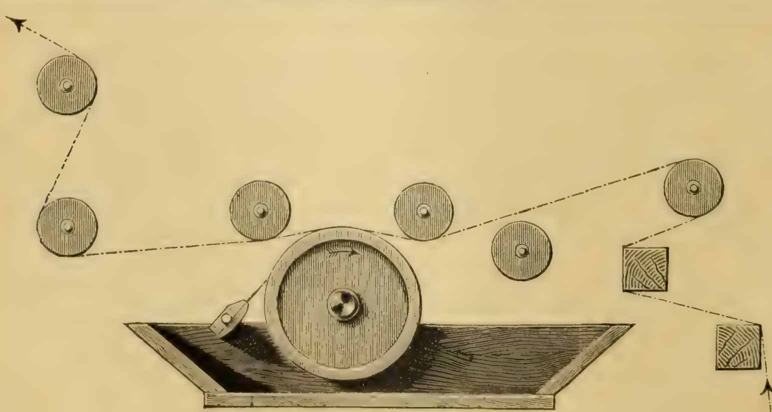


Fig. 15. Section of back starching machine.

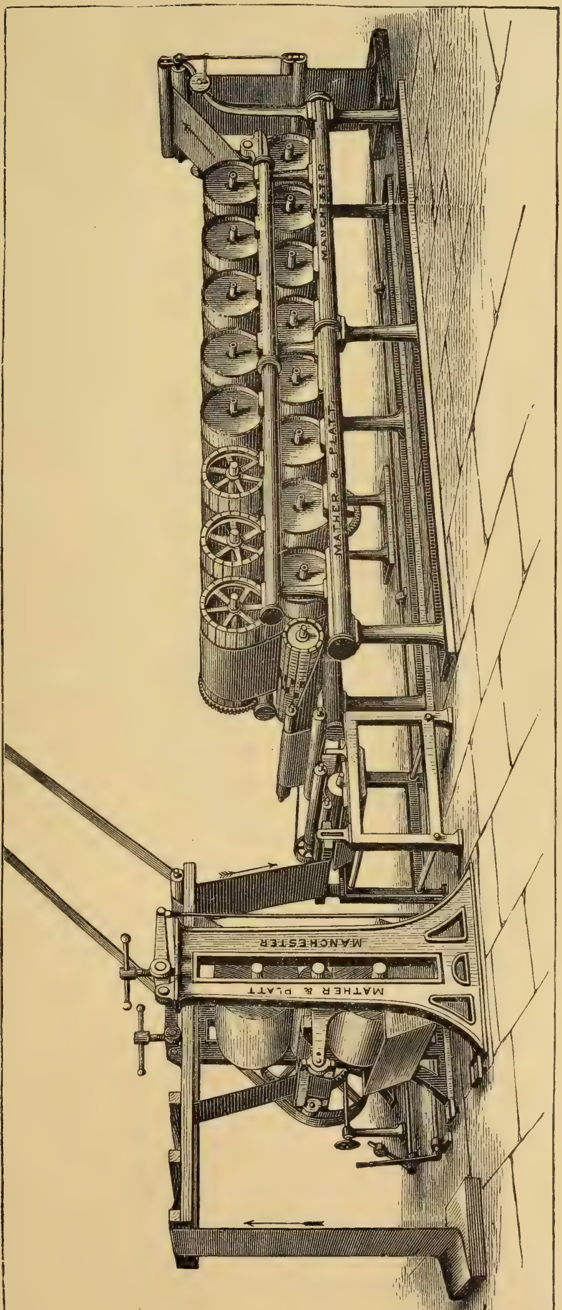


Fig. 16. Complete back-starching and drying range.

can be dispensed with. This machine can also be used as a water-mangle, and for taking out the creases when wet goods are to be stiffened a much better result is obtained by passing the cloth through the water-mangle especially for the back starching machine: the threads being fuller and flattened, the size remains on the surface. The second apparatus is that described ou page 105, after which the piece passes over a stretching roller and is then dried on cylinders, only thirteen of which are shewn in fig. 16 pag. 107: to work rapidly nineteen at least are necessary. At one end of the machine abatching apparatus can be applied not shewn in the drawing. Sometimes there is a jet of steam to »refresh« the cloth.

This last-mentioned starching machine, is certainly one of the most ingenious constructed for some years past. It works splendidly either slowly or rapidly, with heavy or light starch with fine or thick cloths, in a word, it is up to the present moment the best machine in the market for back starching.

The production is enormous; with proper drying machines it dries easily from 20 to 22000 metres, single width, in a working day of ten hours.

ON THE DIFFERENT METHODS AND SPECIAL MACHINES USED IN DRYING STARCHED COTTON GOODS.

All fabrics retain a certain quantity of water after undergoing the operations of bleaching or dryeing and this water must be eliminated. When goods are stiffened they must also undergo a drying process in order to set free the water used in the preparation of the starch.

The method which at first naturally appears the most simple and economical is drying in the open air. This method however, which may be utilized in printing or bleaching is impracticable in finishing, for there is not only the question of time (a factor not to be disregarded at the present day) to be considered but the variations of the atmosphere and in consequence thereof an unsteady and doubtful result.

According to the season, the air is more or less laden with humidity, and consequently drying in the open air must and does render the goods more or less hard or supple, in proportion to the dryness of the air. In other words goods starched and then dried in the open air during dry wintry weather would be more humid and retain more water than goods dried in summer, although weather in relatively damper. This effect is produced by two causes:

1st By the difference of the saturating capacity of air, with respect to the changes of temperature, which may vary in different countries from —5 even —10^0 C. to +30^0 Celsius and upwards. With this first cause there is also the effect of the agitation of the air to be considered. Thus in a calm atmosphere the evaporation is slow; whilst in an agitated atmosphere it becomes more and more rapid, the unsaturated layers being continually brought in contact with the liquid to be evaporated.

The expansion of the aqueous vapor, or rather the difference existing between the expansion of vapor being formed and that already formed in the air, is another cause of the greater or lesser rapidity of evaporation.

According to Dalton's experiments the quantity of liquid which can be vaporized in a given time is always in proportion to this difference of pressure. Thus in perfectly dry air, at 11^0 for instance, as much water can be evaporated, with a given surface as at 30^0 in an atmosphere saturated water.

2ndly By the composition of the starch, which retains more water at a low temperature than at a high one. This water is in a manner incorporated with the paste itself, and when the piece is dried at a low temperature, the yield isalways less,

the moisture being evidently not so completely extracted.

It follows then that, for starched goods, drying in the open air is impracticable, therefore it is unnecessary to enlarge further on this subject.

Drying by hot air, which is done by means of hanging rooms, has its advantages and disadvantages; the buildings constructed for this purpose being usually very high and requiring special arrangements for utilizing the heat; it is generally acknowledged that, for finishing works, except in certain special cases, it is preferable to employ the new and improved mechanical appliances of the present day.

This system costs perhaps less than the drying on machines in certain cases, such as in the finishing of white goods, starched on both sides, and where this impustation of the cloth is a desideration, but it has serious drawbacks. The rooms being generally high, the hot air forms in layers, the highest part being necessarily the hottest, but as the capacity of saturation also depends upon the temperature, it follows, that the highest and hottest layers can absorb the most moisture and appear so much the drier: but when the room is emptied and the outside air allowed to enter, the lower parts, having a temperature approaching nearer to that of the atmospheric air, are always relatively drier than the upper parts, because these

latter receive the condensation of a portion of the humidity caused by the over heated air.

As there is a demand now to produce finishes on one side only and also to preserve the warp and sweft as straight as possible in starching; these which drying rooms generally speaking are only used for certain white goods finished like samples Nos. 2, 4, 6, 22, 24, 26 are gradually being abandoned.

From a humane point of view these drying rooms in case of fire, are most dangerous and cases of workmen occupied at the top of the room being burnt or suffocated are unfortunately of too frequent occurrence.

Such rooms, drying in the open air or by hot air, bid fair to disappear entirely. They are utilized, when already erected, but these immense buildings are rarely found in new establishments, the rooms alone not only producing less but costing more than the machines now in use.

The expenses, such as repairs of the building, repairs of heating apparatus insurance, wages of the numerous work people, danger of fire, atmospheric disturbances, the question of limited production, in addition to the uncertainly of the time, necessary for drying, are sufficient reasons for the abandonment of this system. We will pass now to the study of drying on drums or cylinders, without entering into the different systems, such as hot-flues, steam-chests, drying by superheated air, which have no direct relation to finishing.

As the detailed examination of these systems would extend beyond the limits of an elementary treatise, a list of the principal works treating of this subject is added at the end of this chapter, so as to facilitate the research of readers, who may desire to have precise and detailed information. Under the name drying cylinder we unterstand an apparatus made of a cylindrical bent metal sheet of larger or smaller diameter. The interior is hollow and filled with steam, which heats the sides and thus evaporates the water in the fabric, which is in immediate contact with the outside surface of this cylinder. It is so arranged that at one end the steam enters, and at the other, condensed water escapes by means of a fixed coil, so placed that the end of it is always at the lowest part of the cylinder in which it is fixed. The least inside pressure of steam acts on the condensed water and forces it out.

This cylinder is moved at the same time as the piece of goods which passing over it, which has to be dried, it is driven at such a speed that the piece is perfectly dry on leaving the cylinders.

This is — in the widest acceptation of the word — the definition of the drying cylinder. The modifications, combinations and transformations which the original drum has undergone are innumerable, and we shall describe further on the

multiplicity of systems to which this mode of drying has given rise.

The first use of drying cylinders dates from 1820. An Englishman, *Jonathan Schofield*, constructed the first drying machine with three drums, but he only patented it towards 1824, and it was first used for woollen cashmeres. This system gradually came into general use in England, afterwards in Normandy, but was not known in Alsace and the rest of the continent until about 1840.

The drying cylinders are made of cast-iron, sheet-iron, copper, tinned copper and tinned iron, but this latter is only used in cheap machines, as it soon wears out; the best cylinders being made of copper or better still of tinned copper.

The different systems of mechanical drying may be divided in two great series:

1⁰ drying cylinders or machines.
2⁰ stenter frames.

Before examining in detail each system, a few general observations are necessary. A light woven fabric will dry more easily than a thick one under simular conditions that is to say, 10 kilos of a light cloth will dry more easily than 10 kilos of a heavy one, the quantity of water to be evaporated being the same, because the penetrating effect of the liquid and the surface to be dried must be taken into account.

An ordinarily starched fabric will dry more easily than a heavily starched one, i. e. 10 kilos of cloth having absorbed 10 kilos of liquid starch, containing 7·5 kilos of water, will dry more easily than a fabric weighing also 10 kilos, stiffened likewise with 10 kilos of starch containing also 7·5 kilos of water, but 1 or 2 kilos being of »clayey, instead of amylaceous substances. When fatty matters are added the drying requires to be more thoroughly carried out.

We have already noticed that the great disadvantage of the cylinders is, that the size sticks to them; we have also given the remedy, but even then this deposit is a serious drawback especially when two sorts of thickening mixtures are used without changing the lappings. (1)

All drying Machines have further the disadvantage of the cloth coming in contact with the heated metal surface whereby the threads are more or less flattened and this evil is increased where both sides of the cloth alternately pass over the cylinders, on the other hand if dried without contact with the cans or metal surface the thread will remain round. This explains one of the great advantages of drying on stenter frames besides the question of stretching, finishing and keeping the warp and weft straight.

(1) The cylinders are often covered with a few rounds of calico to prevent the starched goods adhering to the metal (these coverings are called „chemises" in French).

For coloured fabrics the contact has great influence; in cooling, the lustre of the colour generally reappears but sometimes its brilliancy is diminished and cannot be restored.

In cylinder drying machines, when the face and back of the cloth are alternately in contact with the cylinders, printed steam-styles, not washed, are liable to run, therefore this system of drying must be avoided for this class of goods. Amongst the other serious inconveniences in cylinder drying are the shrinking of the cloth in width which cannot always be regained afterwards by stretching, the distortion of the warp and weft and the difficulty of keeping these threads at right angles; should the piece enter the machine irregularly the selvages may easily be torn.

Such are the principal drawbacks to the cylinder drying machine.

The advantages are economy of fuel, facility and rapidity of drying and the great production; but however important these may be, they do not always compensate for the inconveniences.

CYLINDER DRYING MACHINES.

These are constructed with one or several cylinders according as may be desired for drying slowly or rapidly. When the cylinder is to be used as a stenter, generally only one drum is employed, which is provided with »pins« or »clips« as in fig. 17, pag. 117.

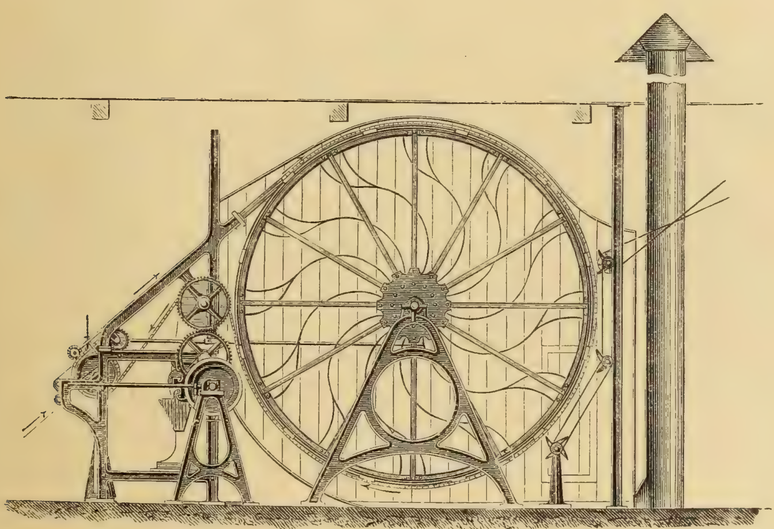


Fig. 17. Cylinder pin drying machine.

These system of drying is little used, as its drying power is small and the loss of heat considerable, besides the piece shrinks, is dragged and the warp and weft become distorted, moreover repairs are frequent and delicate thus this one cylinder machine must inevitably be abandoned.

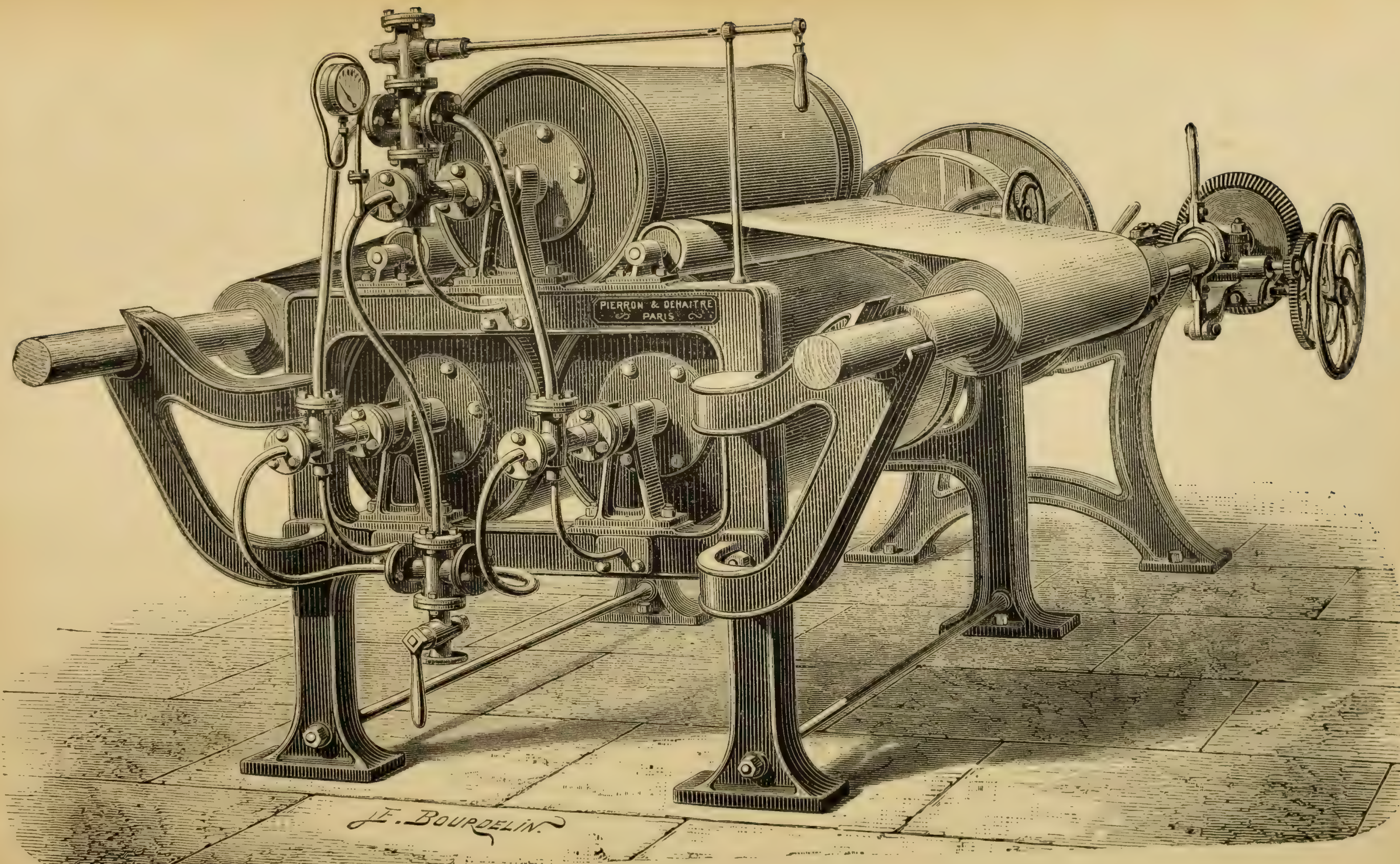


Fig. 18. 3 cylinder drying machine. (One width.)

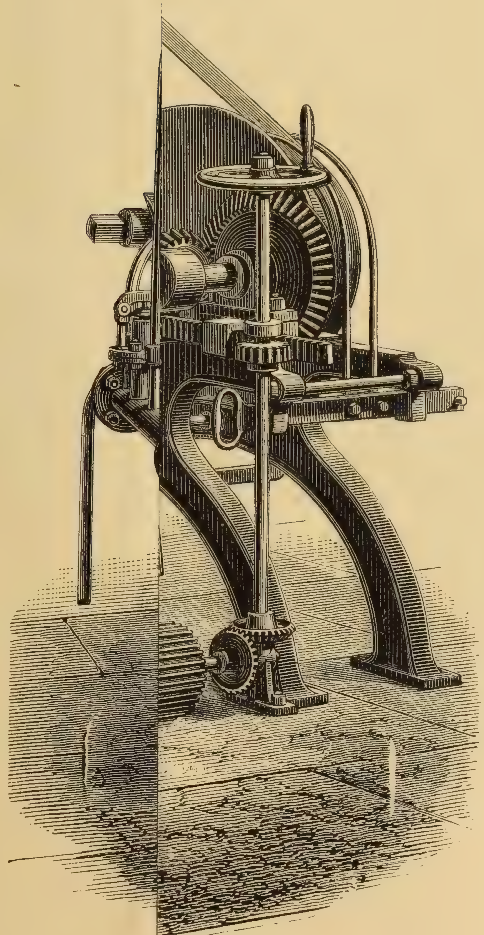


Fig. 18. 3 cylinder drying machine. (One width.)

FOLDOUT

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DIGITIZED

A second type is the machine with three cylinders. It is used principally for woollen fabrics and certain furniture styles. For the latter, as it is often necessary to give a certain appearance to the cloth without evaporating much water this machine renders great service. It is provided with a pedal not represented in the drawing, and which enables the two workmen, who superintend the operation to stop the machine, to allow the cloth to remain on the cylinders, until it is completely dry, as well as to straighten the selvages and guide the fabric, through the machine from entering until it is batched. It is clear therefore that this machine can only be used for completely soluble thickening materials and that there can be no question of employing it for starches charged with insoluble or mineral matters.

This machine is principally employed when the cloth is to be softened by breaking the thickening already deposited with the colours on the cloth, by the action of the steam, which, in evaporating, carries away with it, the last traces of acid, not removed by steaming. This is the case in furniture styles with unwashed grounds such as are largely manufactured in England.

Fig. 19, page 120, represents a drying machine similar to the preceding, but it works more rapidly. The arangement is for only one width of material and we have already noticed

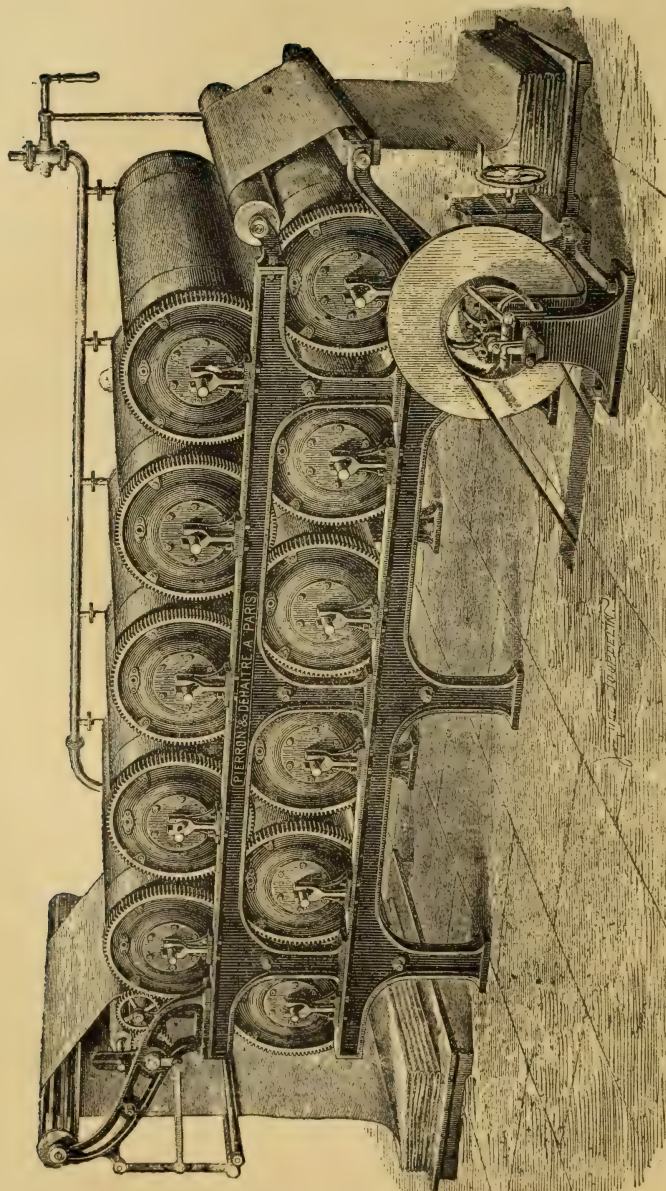
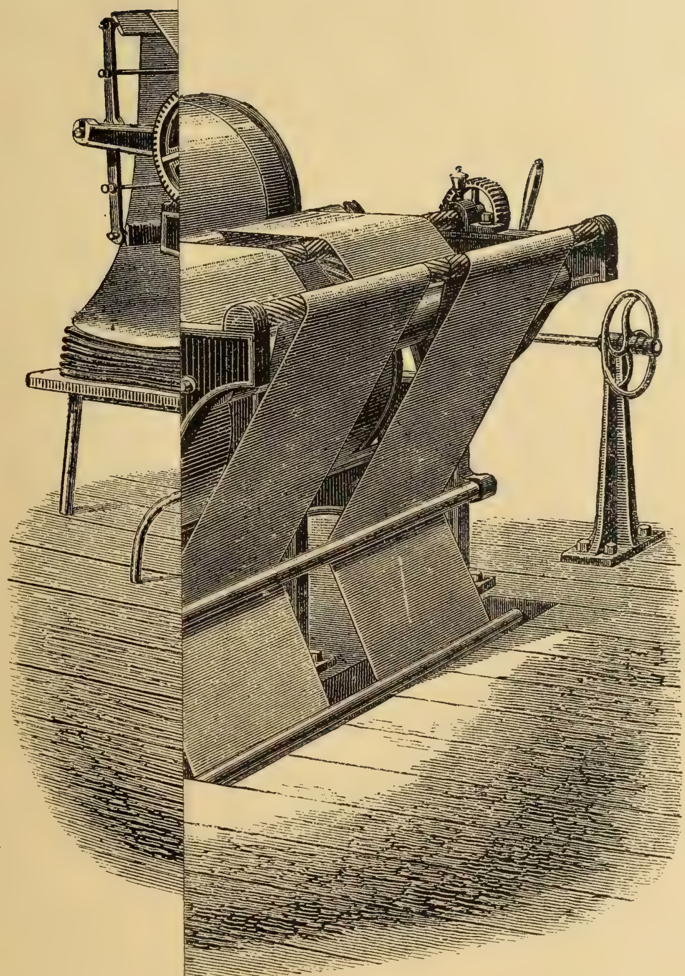


Fig. 19. Drying machine with 11 cylinders for one width. Side with the friction motor.



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a similar apparatus combined with a starch mangle fig. 11.

Fig. 22, page 123, represents a similar machine with 11 cylinders seen on the side of the steam outlet.

Drying machines, where the surface and back of the piece come alternatively in contact with the cans are very good for ordinary and unweighted styles. But it is evident that with this kind of drying machine, it is difficult to guide the piece and there is the disadvantage of the great stretching and tension of the cloth passing over so many cylinders. The fabric can lose as much as 10% and even more of its original width, that is to say, its width before starching. For instance, with handkerchief styles, care is taken to stretch them as little as possible and to widen them by hand as much as possible before the piece touches the first cylinder.

We find this arrangement in machine shewn in fig. 20, page 120 B., the pieces are starched in a room below, ascend through an opening in the floor on to the machine before which is an open space for the workmen who straighten or guide the cloth according to the requirements of the process.

When the cloth has only to touch on one side, the arrangement adopted, is that represented by fig. 21, p. 122.

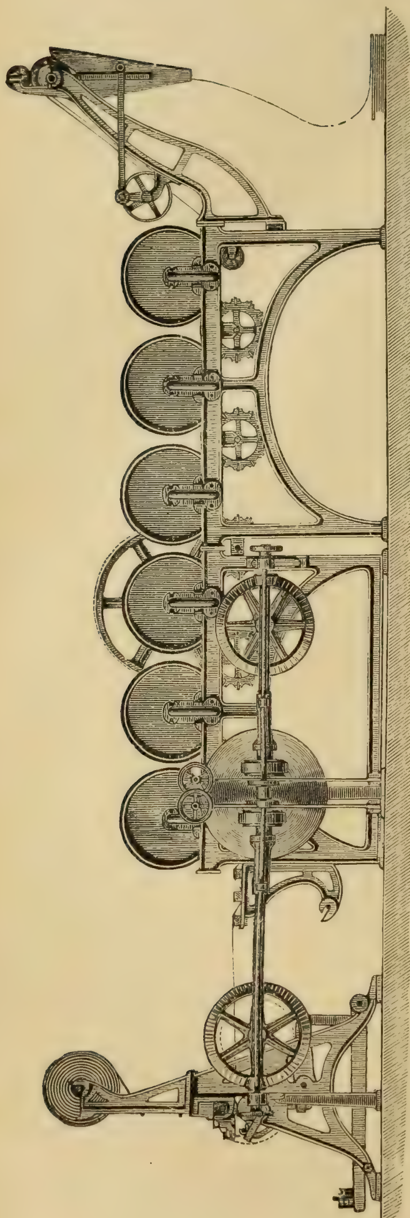


Fig. 21. Drying machine for one side (with wood lagged rollers).

This kind practically represents the diagram of plate III, fig. 13 (see the plate after page 90).

The three preceding kinds correspond with the diagram of plate III, fig. 10.

Vertical or upright drying machines are also constructed and this system offers advantages over the horizontal drying machine when space is limited as it takes up much less room.

Fig. 24, represents a machine with 16 cylinders drying on one side of cloth (single width) the machine can be worked with 8 cylinders or with 16 (double set).

Fig. 23, page 124, represents a similar machine, driven by a variable friction gear which enables the speed to be varied at will. For goods stiffened on one side, some of the cylinders at the going in end are generally replaced by wood lagged drums. A plaiting

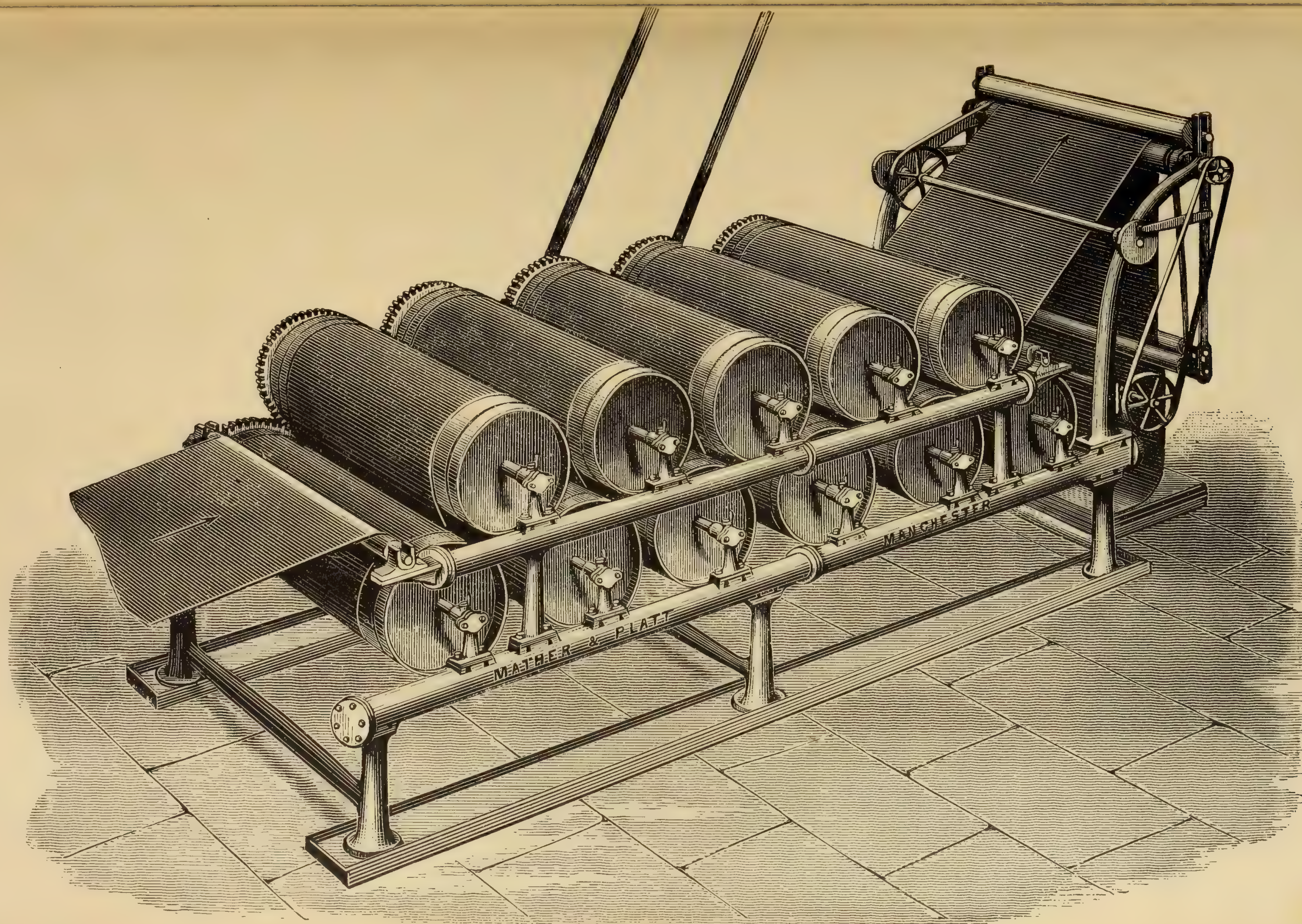


Fig. 22. 11 cylinder drying machine for one width. View of the opposite side to the motor.

down or a batching apparatus is generally applied at the going out end.

The preceding figures and descriptions represent pretty nearly the generality of drying machines and the reader will thus readily understand

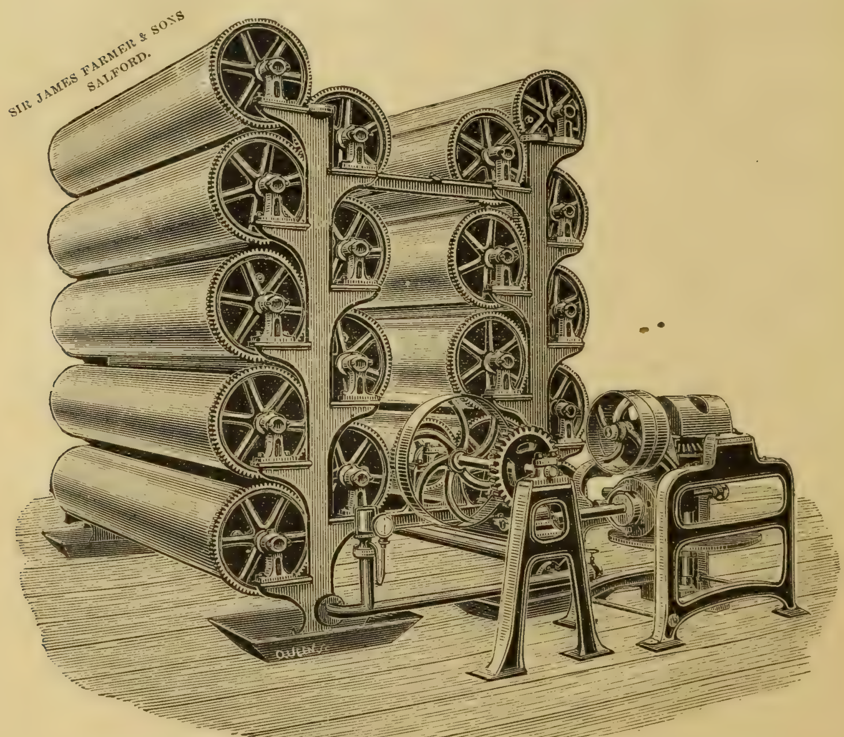
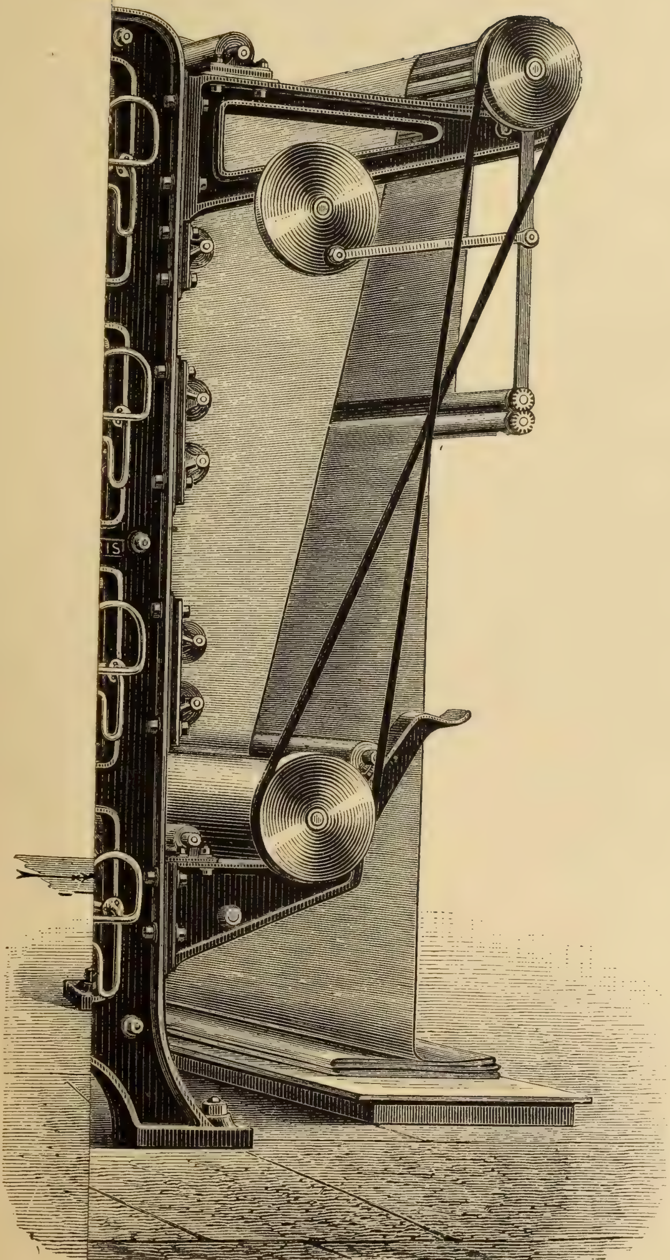


Fig. 23. Farmer's upright drying machine with 18 cylinders double width (drying on both sides).

their features and manner of working. The most complete and practical machine, is that represented in diagram, plate V. fig. 22, on which all possible styles can be dried, that is to say, with:



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contact on both sides,

contact on the right side or surface only,

contact on the reverse side only,

whatever may be the style of starching employed: open trough, on the surface alone, or on the back of the cloth.

In machines drying on both sides the starch easily adheres to the cylinders, this drawback is remedied by covering the first two or three cylinders with a thick cylindrical lapping, and which can be easily removed when it gets too much coated with the thickening. If this precaution be not taken, there is a risk of spoiling the fabric as the starch will be deposited in patches. Work must be suspended in order to clean the cylinders, and as this cannot well be done when they are hot, it is necessary to wait until they cool thus losing time. As we have already said it is far the best in drying back starched goods that the surface only of the cloth comes in contact with the cans. — Vide diagram Fig. 11, plate III, the thickening dries quicker, does not penetrate so much.

Besides the systems we have just reviewed, there are others such as the 3 large cylinder machine, system Huber.

This apparatus consists of three large drums or

cylinders similar to the one represented in fig. 17, page 117. Its production, as may be readily understood is in proportion to the heating surface and much more considerable than that of the single one.

It is difficult if not impossible to determine the production of each kind of apparatus for each fabric on account of the variety of sizes and the diversity of cloths employed. For instance six kinds of drying machines with as many kinds of fabrics will produce with one starch mixture thirty six different results, and should the thickening vary, the results would be innumerable. It is scarcely possible that all these varieties have been tried by the same person. There is no information on this subject and it is very improbable that any one, however experienced, has operated in all these styles.

We can only give practical results obtained in a few cases. Yet the calculation of the production of a drying machine presents no very great difficulties. The pieces should be weighed before and after starching, the starch also must be accurately weighed, the heating surface of the machine with the utilized and non-utilized parts noted, the condensed water coming from the machine collected, the pressure and humidity of the steam taken into account, the temperatures corrected and the whole brought to a unit.

To be scientifically exact it is evident that numerous other precautions should be taken, but for the manufacturer it is above all necessary to know if he makes the most of his coal or whether he can further economise. These means therefore will give sufficient indications, but the working capacity of the boilers (1) must not be forgotten, as it is of the greatest importance. It is evident that, if the steam produced by one boiler is 20% less than that produced by another, the one producing the most will give, with the same drying machine, better results; the working capacity of the boiler is therefore a most important point and much depends upon it.

We give further on two tables of observations, made in the manufactory, but merely by way of information, as it would be imprudent to draw any

(1) Whatever it may be in theory, in practice we are still far from making the best use of coal; at the present day it is known that one caloric or unit of the measure of heat, i. e.: the heat necessary to raise the temperature of 1 kilo of water at 0^{0} to 1^{0} centigrade and in a liquid state corresponds to 425 kilogrammetres. The kilogrammetre is the unit of measure of the work required to raise a weigth of 1 kg. 1 metre in height; 75 kilogrammetres correspond to one horse power. 1 kg. of coal of good quality gives 7600 calories or 7600×425 or 3410000 kilogrammetres. — Supposing this kg. burns during 3600 seconds or one hour, it will produce 3.410.000 : 3600 or 947 kilogrammetres or 12 horse power and 47 kilogrammetres. For one horse power about 80 grammes of coal must be employed — our best boilers consume from 6 to 700 grammes, which is nearly 7 or 8 times the necessary quantity.

conclusions therefrom; what can be certified is that the drying cylinders dry:

1. In proportion to their surface of contact.

2. In proportion to the lightness and fineness of the cloth.

3. In inverse proportion to the strength of the starch.

TABLE I.

NUMBER OF TESTS	KIND OF DRYING MACHINE	PRESSURE OF STEAM	DIMENSION OF DRUMS		TOTAL SURFACE OF APPARATUS	KIND OF CLOTH	PRODUCTION IN 10 WORKING HRS.
			DIAMETER	CIRCUMFERENCE			
1	2	3	4	5	6	7	8
		ATMOSPHÉRE	METRES	METRES	METRES		METRES
1	Drying machine with 7 drums or cylinders	$2^1/_2$	0.50	1.570	10.990	Twill 9 ribs	7900
2	with 3 drums	3	0.60	1.88	5.640	Cretonne 13 kilos.	5200
3	« 9 «	$2^1/_4$	0.50	1.57	14.130	Calico 60 P.[1]) 16 T.	8400
4	« 7 «	$2^1/_2$	0.50	1.57	10.990	Cretonne 16 kilos.	5800
5	« 7 «	$2^1/_2$	0.50	1.57	10.990	Ct. 30 (Rouen)	8600
6	« 7 «	$2^1/_2$	0.50	1.57	10.990	Cal $^{21}/_{22}$	7000

[1]) Portée is the french term used in the Cotton trade for the standard sett in weaving one portée consists of 40 warp threads, thus a fabric of 60 P contains $60 \times 40 = 2400$ warp threads (always understood per 90 cm. or 35 7/16").

TABLE II.

NUMBER OF TESTS	KIND OF DRYING MACHINE	STYLE OF FINISH	MODE OF APPLICATION ON THE CLOTH	PATICULARS OF CLOTHS			WEIGHT OF 100 METRES OF CLOTH IN THE GREY STATE	WEIGHT OF SIZE EMPLOYED FOR 100 M.	Production of 1 metre of surface in working direction	
				Name	Width	weft-picks			drying per hour	evaporation of size
1	2	3	4	5	5	7	8	9	10	11
					CENT.		KILOS	KILOS	METRES	KILOS
1	Drying machine, with 7 drums	**Ord^y Mangle unweighted size**	Pl. II fig. 1 and Pl. III fig. 13	Twill 9 ribs.	90	—	9 k. 300	11	71	7.900
2	« 3 «	**Doctor unweighted size**	Pl. II fig. 3 and Pl. III fig. 10	Cretonne 13 kilos.	90	—	13	14	92	12.000
3	« 9 «	**Open bath, unweighted size**	Pl. II fig. 4 and Pl. V fig. 20	Calico 60 P. / 16 threads	90	$^{16}/_{16}$	7.8 to 8	12 k. 500	59	7.300
4	« 7 «	**Doctor unweighted size**	Pl. II fig. 3 and Pl. III fig. 10	Cretonne 16 kilos.	90	—	16	16	52	8.360
5	« 7 «	**Doctor unweighted size**	Pl. II. fig. 3 and Pl. V. fig. 20	Cts. 30 (Rouen)	90	—	6.8 to 7.5	11	78	8.540
6	« 7 «	**Ord^y Mangle slightly weighted size**	Pl. II fig. 2 and Pl. III fig. 13	Calico $^{21}/_{22}$	90	$^{21}/_{22}$	11.5 to 12	11.5 to 13	53	8.270

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Observations relative to the annexed tables.

The surface is that of the whole apparatus, but does not imply absolute contact. The degree of contact depends on the drying machines. The tests were made in summer during 4 consecutive hours and required 10 hours of effective work, the time occupied in starting and in stoppages not reckoned.

The size for the majority of the tests was not »weighted« and in some cases was in a very fluid state. The steam pressure, indicated is that of the boiler and not of the drying machines.

In calculating the production, the whole width of the cylinder is not taken into account. We have admitted one metre of surface and the whole width, whatever the kind of cloth to be dried may be.

Drying by contact on both sides, or by contact on one only is particularly specified in column 4, table 2.

THE REMOVAL OF STEAM PRODUCED BY DRYING MACHINES.

All mechanical drying apparatuses produce steam, which must be expelled from where the sizing is carried on. Ventilation for getting rid of free-steam is not only useful, but indispensable to facilitate the cooling of the ordinary air, which, if not renewed, becomes unbearable to the work people and charged, with moisture. The goods after leaving the hot cylinders and then cooling, reabsorb a certain amount of humidity if the air is overcharged with steam vapours. It is therefore essential to have on all premises containing drying machines, sufficient ventilation to remove this excess of humidity.

When the ventilation is imperfect, the vapour is condensed and the drops produced by condensation, cause much inconvenience: goods may even be so spoiled as to be incapable of being restored. The water from the condensation of steam dissolves certain particles, coming from the wood or carries with it particles of rust or other metallic bodies which fall on the cylinders or on the goods and spoil both machines and cloths.

To remedy this inconvenience hoods are placed above the drying machines these woods having chimneys or trunks to convey the steam out of the building.

The simplest form of hood is made of a framework of laths, on which is nailed calico or still better old woollen or india-rubber blankets; laths covered with felt are also used. When the machine is in work, the felt absorbs all the steam which, when the machine is stopped, is evaporated by the heat, produced by the machines, and which accumulates in the building. The steam is thus conducted by these chimneys outside the building, and they should be large enough to produce a strong draught.

Woods are also made of thin boards, but this cannot be recommended as after a certain time the wood warps and ulmic acid exudes and forms stains. The nails in these chimneys rust easily, and often produce iron-mould spots. It is true they may be tinned, but even then the metal becomes oxydized and the spots reappear.

Roofs made of galvanized iron sheets are more recommendable. The sheets are first folded so as to form two half circumferences, soldered together. They are placed in a slanting position and provided with a gutter through which the water flows away. None of these systems prevent condensation nor iron-mould and wood stains which are more liable to be formed in damp weather. Double chimneys have also been tried, they are formed of planks covered with felt, and then recovered with wooden planks. The final result in however always the same, and in spite of all these diffe-

rent systems drops of condensed water cannot be avoided.

Ventilators are now used in preference as they remove the steam and renew the air at the same time. They are fixed in various ways. Fig. 25, page 135, represents a ventilator, fitted to the rafters of the roof, the air escaping through a chimney placed in a vertical position.

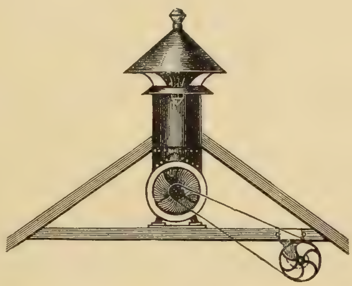


Fig. 25. Ventilator fitted to the roof.

Fig. 26, page 137, represents a ventilator fixed to the ceiling and having an outlet through the side of the room. These different apparatuses work by means of a strap, driven by a pulley fixed on the principal shaft of the workshop.

Fig. 25B, page 136, represents a Blackman air propeller applied to a drying machine. It is one of the best and cheapest in the market; is very easily applied and gives excellent results. —

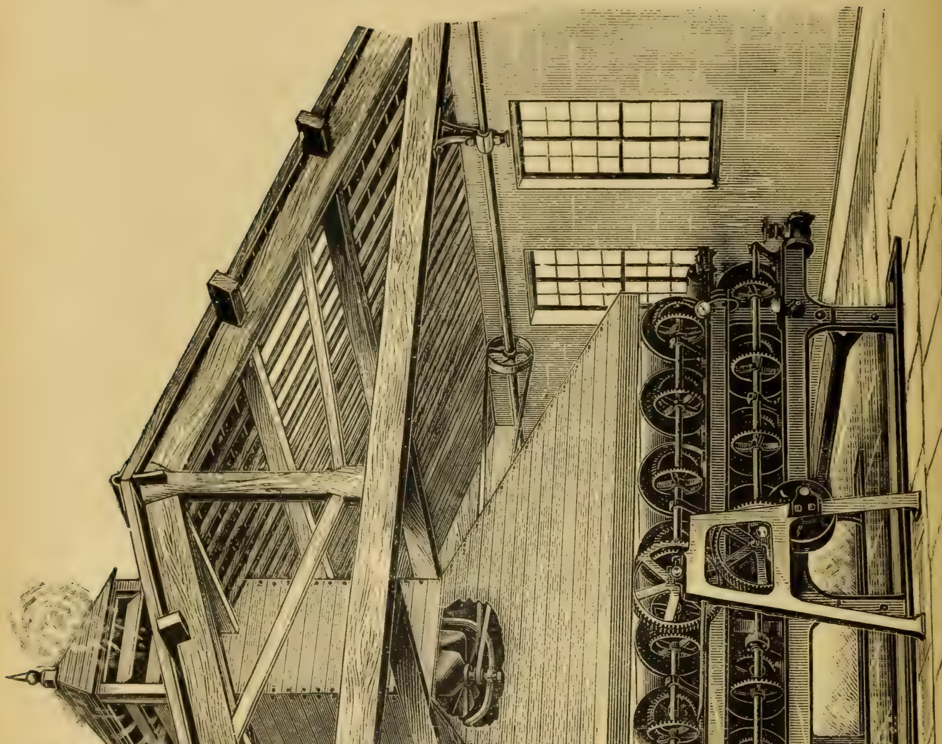


Fig. 25B. Blackman air propeller.

It is evident that, for the effective working of the ventilator, attention must be paid to the entrance for air.

Injectors are also used and are perhaps preferable, but they are more expensive. The arrangement is as follows: A hood and trunk is placed over the machine and in the middle of the chimney is placed the injecting apparatus, to which a little steam pipe is fixed; underneath the apparatus is

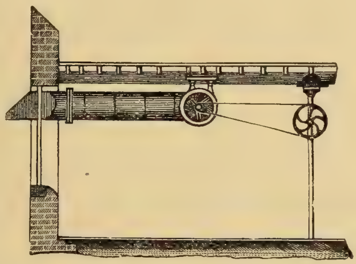


Fig. 26. Ventilator fixed in the ceiling and working at the side.

a vessel or sort of cup in which all that is condensed or that may fall from outside collects and to which an outlet or discharging tube is fixed. If the steam is turned on, it carries the wet steam of the apparatus with it into the injector, and at the same time renews the air in the chimney. It is worked as the weather and requirements of the work shop demand. This apparatus is extensively used notwithstanding the heavy expense of fitting up and the repairs.

STENTERS OR STRETCHING FRAMES.

When cloth is dried with the single aim of removing the moisture it retains, either drying sheds, or drying machines are employed, but when the cloth is to be dried and at the same time the width regulated, according to the position of its threads, which should form a right angle, or the arrangement of the patterns, which should be repeated at regular distances, stenters or »*St. Quentin frames*« are used.

The stenters may be divided into two classes.

1⁰ Fixed stenters.

2⁰ Continuous or progressive stenters.

Each of these classes can be subdivided into stenters without shaking apparatus and stenters with vibrating apparatus. In the operations of bleaching dyeing and finishing the weft and warp of cloths often become disconnected and displaced or »warped«. In order to put these threads right again and give the fabric its former appearance they undergo an operation called stretching or tentering (*déraillage*).

This consists in stretching the tissue on a stenter or frame provided with pins or clamps in short with means for holding the selvages of the cloth, care being taken to place the weft in its normal position with regard to the warp. This

done a movement of oscillation or vibrating motion is given to the weft, the warp remaining continually stretched and parallel to itself or the longtitudinal axis of the stenter. These threads thus put in movement after a certain number of oscillations, gradually recover their original position.

In the finishing of certain fabrics it is better to dry after stiffening and in making them undergo these oscillations during drying, a peculiar feel and appearance are obtained called the »*elastic*« finish — (*apprêt brisé.*)

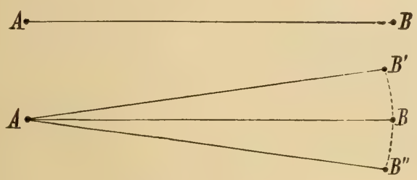


Fig. 27.

This elastic finish is done in several ways, as represented in the following diagrams. Let us suppose that we are working with only one thread of the weft. If this thread be fixed at its two extremities A and B, various movements can be imparted to it. In the fig. 27, page 139, the line AB represents the thread stretched out, AB′ the second position and AB″ the third position. In these different movements the point A remains fixed, and all the other points from A to B describe and arc with A as centre and AB as radius. If the operation be reversed and B taken as centre, and A the point that changes its position, the positions will be respectively symmetrical,

and the warp in these conditions will by impulse describe the same movement.

In fig. 28, page 140, we will suppose the centre C in the middle of the thread AB, and as the two sides of the stenter are moveable we shall have first the position AB, then A′CB′, and lastly A″CB″ to return to ACB.

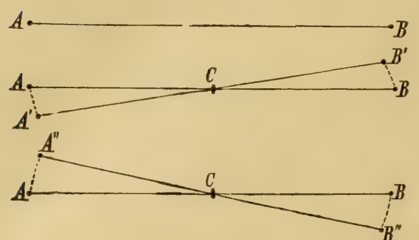


Fig. 28.

The fabrics are fastened to two moveable frame sides; which move as easily lengthways as transversally and both may be moved in the same direction or the direction may be alternated, that is to say, the frame side A, can be pushed forward, whilst the frame side B, is drawn backwards, the movements in fig. 27, page 139 and 28, page 140, are thus obtained. If A and B are brought nearer together or if A is moved farther from B a third movement will be produced as represented in fig. 29, page 140.

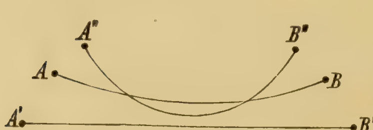


Fig. 29.

In this figure the line AB representing the thread is not straight, the thread here being simply placed on the stenter, previous to stretching. We

have thus the three following positions: AB then A″B″ which is produced by the frame sides or moveable sides being brought nearer to each other; in placing these farther apart we return to AB, to obtain at length the position A′B′ which represents the greatest separation of the thread.

These before mentioned movements are easily obtained by the stenters, and we intend taking up the study of each apparatus. The necessary mechanism of tentering and stretching the cloth is adjusted to each machine according to require-

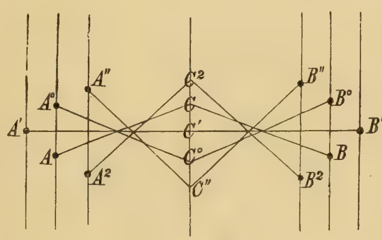


Fig. 30.

ment. As a general thesis the vibrating apparatus is only used with fixed stenters, we shall however have an oportunity of studying a continuous stenter to which a vibrating apparatus is applied.

Fig. 30, page 141, represents the different movements which can be given to the same thread when the action of oscillation has its starting point in the middle of the cloth.

Take the point C^0 — the thread being represented by A^0C^0B, the frame sides fixed to two sorts of connecting rods and fastened to a median

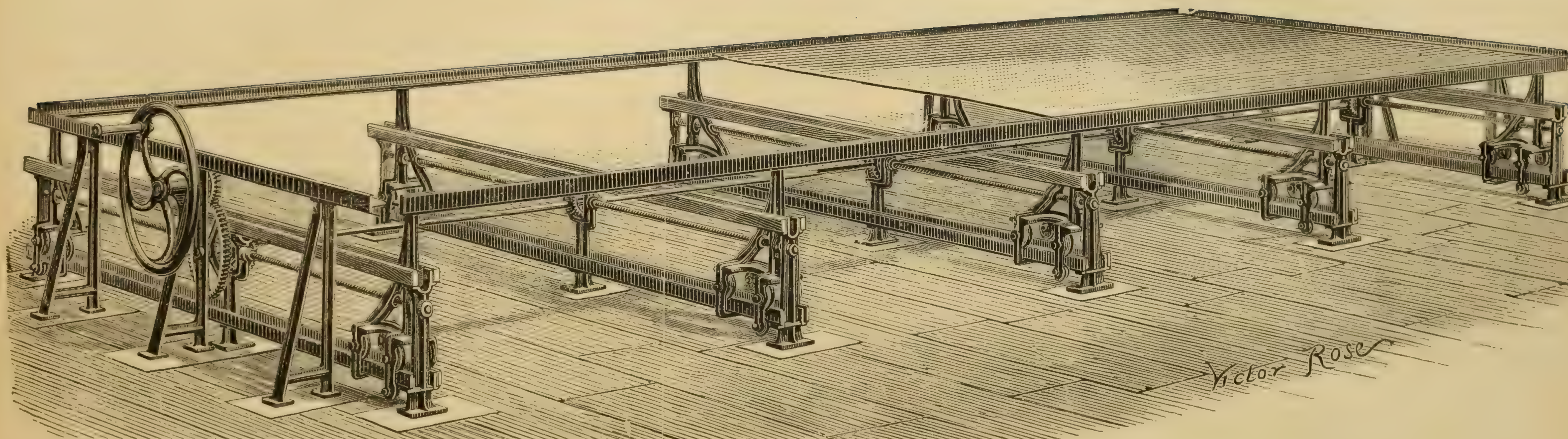


Fig. 31. Pin stretching machine or stenter with simple motion. [See page 144.]

rod, the centre C can occupy a series of positions similar to those in fig. 30, page 141, but on this side of and beyond the straight line forming the maximum opening. For instance let us take as starting point $A^0C^0B^0$ and by drawing the centre rod towards us (we are supposed to be working on a horizontal plane) we shall have the position $A''C''B''$, which represents the maximum that can practically be given to a piece, and which represents about $^1|_8$ of its width; to go beyond might spoil the fabric. If we push back the centre rod we return to $A^0C^0B^0$, and continuing in the same direction we have the line $A'C'B'$, which is the maximum width the straight line; a greater stretch would risk breaking the thread, and continuing the same movement we get the position ACB symmetrical with $A^0C^0B^0$, then $A^2C^2B^2$ symmetrical with $A''C''B''$. These different motions to and fro when repeated, represent the best system of vibrating motion or elastic finish.

Before studying each system of stenters we may observe that the mode of fastening the fabric on the machine is independent of the machine itself and that for fastening purposes, pins or clips are employed. Before entering into the details of these different methods of fixing, we shall review the numerous varieties of stenters.

FIXED STENTERS.

The simplest stenter fig. 31, page 142, consists of two frames on which are fixed the pins or clips. These frames are arranged on uprights placed on rollers, in the middle of the apparatus is a long rod, provided with bevel wheels communicating with each series of uprights; at one end of the frame is a hand — wheel by which the distance between the frames can be lessened or increased and the tension of the fabric is thus obtained. These stenters, which are the simplest, are placed in very hot rooms and the cloth is left on the stenter until the required desiccation has taken place. This kind of stenter is used for very light goods such as tulles; its manipulation is too expensive for ordinary cotton fabrics and its production is very small.

The stenter fig. 32, page 145. represented in our drawing with clamps or clips is similar to the preceding one, but is so arranged as to give a reciprocating motion. The stretching is effected by means of a screw, which expands the two frames; the tension of the piece is effected by means of a screw placed underneath the stenter; the to and fro motion is given by turning, with the hand, the circular metallic piece fixed at the end. One of the sides being displaced it forces the other to move in the opposite direction and

the repetition of this movement indicated, in fig. 28, page 140, causes the vibrating motion.

All stenters of this construction ought necessarily to be of the same length as the piece. The heating is done in different ways: by the hot air of the room, with hot air by steam chests placed underneath the cloth to be dried, and by steam in gilled pipes. Stationary or fixed stenters are principally used for jaconets, book-muslins, tulles and light fabrics; but in the finishing of printed cottons they are gradually being superseded by the continuous or progressive stenters, which are now constructed with vibrating motion and elastic finish necessary for these styles of goods.

The tension in the fixed stenters is produced in different ways; in some systems only one of the sides is fixed and on the movable side is placed a metallic rod, provided with cogged wheels over which weighted chains pass; these chains give the required tension, simultaneously either by being partially regulated, or by the rod turning the wheels which are fitted to it and over which the chains pass. One of the frame sides is sometimes provided at regular distances with leather straps, which are rolled round a shaft, this shaft is the same length as the stenter and according to the direction in which it is turned will stretch or slacken the fabric.

Sometimes the two frames or carriers are provided with cranked levers, connected with a central

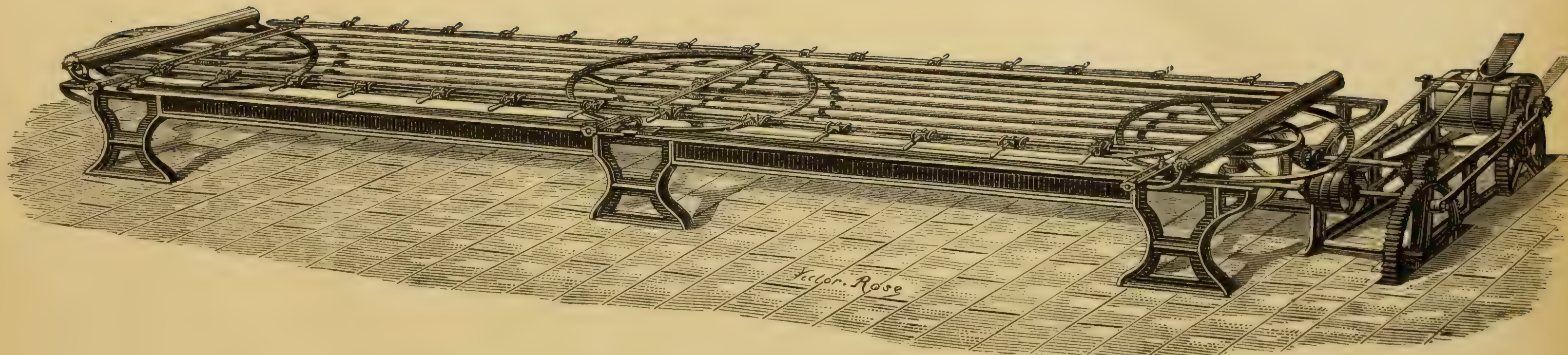


Fig. 32. Fixed stenter with clips for plain finish.

rod ; the reciprocating motion of which produces the vibrating motion indicated fig. 30, page 141. Lastly the frames or carriers can be placed on rollers, running on movable rails, which when turned, cause the two sides of the stenter to advance or recede.

As the fixed stenters occupy a considerable area one contrives to place as many as possible in the same room so as to economize space: five and even six are placed one above the other, in this manner the work can be accomplished without interruption, for by the time the material has been placed on the last stenter the fabric on the first will be dry and can be taken off.

One of the great drawbacks of the fixed stenters is, that in general it does not produce much and takes up a great deal of room, but on the other hand it possesses the great advantage of giving a particular feel, in consequence of the cloth not being in contact with the drying apparatus. The thread remains rounder and is more swollen when the stretching and regulating motion has been well carried out, an evenness, a fineness and a certain feel are given, which is rarely or never obtained with the continuous stenter. For coloured goods dried at a low temperature fixed stenters are invaluable, as by them a superior finish is obtained and the colours remain much brighter than when brought into contact with a metallic surface.

CONTINUOUS STENTERS.

The very small production of the fixed stenters and the large space they take up led necessarily to the finding of some means for the mechanical and continuous working of this apparatus. This was accomplished about thirty years ago, and to-day we have the continuous stenters with or without contact producing considerable quantities and using less fuel than the primitive fixed stenters, and there are even some continuous stenters without contact, with stretching and vibrating motion producing the same results as regards quality and quantity.

The first continuous stenters were used preparatory to printing the fabrics that is they were employed to straighten the threads of the goods so that the pattern printed on them coincided exactly with the cloth; after the printing and its different operations the finish was given on the fixed stenters. At the present day the continuous stenter is used for white as well as for printed goods. It is almost unnecessary to state that printed goods, which have to be starched and finished on the stenter, should pass through the stenter before being printed. For should the printing or the pattern be badly placed on the cloth, the stenter could not straighten it. Thus in order that the finishing of goods may be effective and the end in view

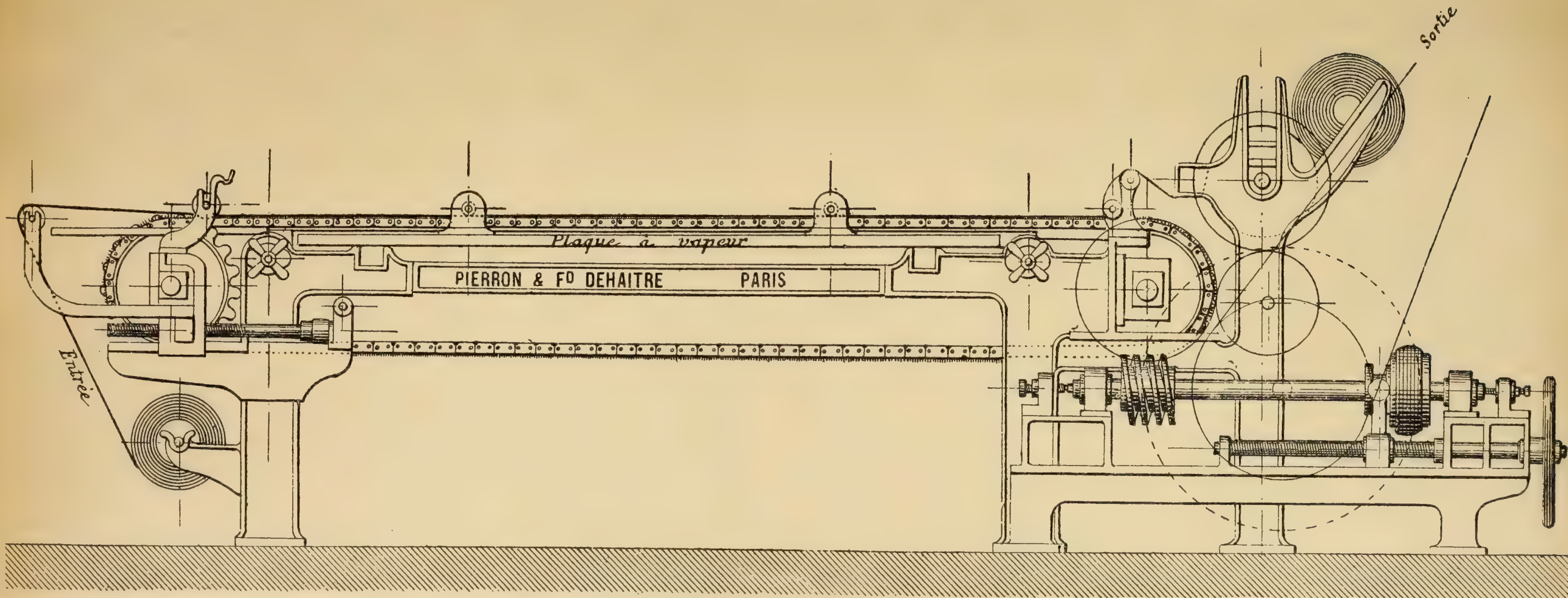


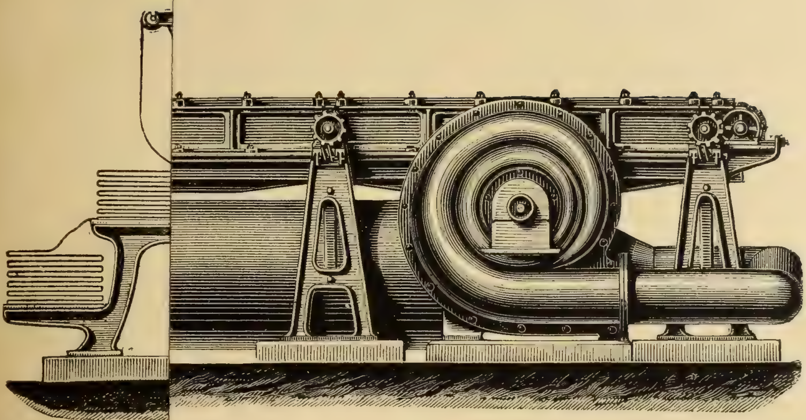
Fig. 33. Continuous stenter with needles.

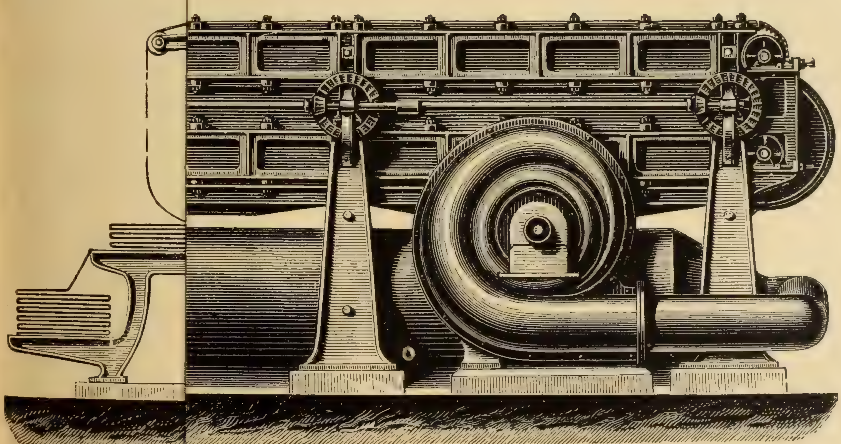
attained they should be passed at least twice over the stenters — the first time for the first printing and the second for the finish without prejudice to the intermediate passages for printed styles which have to be executed by machine and hand.

One of the simplest continuous stenters is that represented fig. 33, page 149′, with needles and having open link chains which run over two wheels, situated at each extremity of the stenter. The cogged wheels are supported by a cross-piece, attached to a support provided with a groove. This cross-piece is traversed by a screw, which allows the two chains to be stretched at will. In our drawing we have only shewn one steam chest for heating but either steam chests or hot air may be used.

This kind of stenter is invariably made for one width of cloth as it would be difficult to make the necessary rapid changes for various widths.

In the illustration the stenter is without a starch mangle; the piece has been batched after damping, mordanting or starching. Any kind of mangle can be combined with this stenter, care being taken to leave a sufficient distance between the mangle and the stenter for the workman who guides the piece at its entrance into the machine. Formerly two women were employed, besides assistants, who were provided with brushes and were charged to rectify the parts of the stuff not fastened to the stenter, but at the present day one person suffices.





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On the front of the stenter and on each chain is fitted a circular brush, which, in its rotation, carries the cloth along with it and forces it on to the needles of the chain. In this manner the workwoman, who guides the stenter, has only to see that the selvages are at the determined width, so that the cloth may be carried along by the brushes, and fixed on the clamps or pins of the chain. Behind the stenter is a batching apparatus.

These kinds of stenters are from 20 to 30 metres long and are provided with a friction plate, which enables the speed to be varied according to the requirements of the drying operation.

They have been much improved as represented by the two drawings fig. 34 and 35, page 150 A. The space has been economized by causing the chain to return; this modification, although of no great importance except with cotton goods, ought to be taken into consideration, for with wool, an elastic fabric, the needles are set at an angle so that the cloth, when underneath the chain may not fall. With cotton goods it is different: if the needles are fixed obliquely they make larger holes and the selvages are easily torn; this drawback is remedied by placing the needles or the pins straight, and covering them with a kind of envelope which grips the cloth.

Fig. 34, page 150 A, has a simple return of the chain and fig. 35, page 150 A, double return, the piece comes out from below the stenter and can be simply folded or rolled. In these two

drawings the entering is badly represented, the piece passing below the workwoman so that she can guide it in front. The disposition should be similar to that shewn in fig. 37, page 152 A.

As these stenters take up a great deal of room many combinations to economize space have been tried; for this reason, circular stenters have

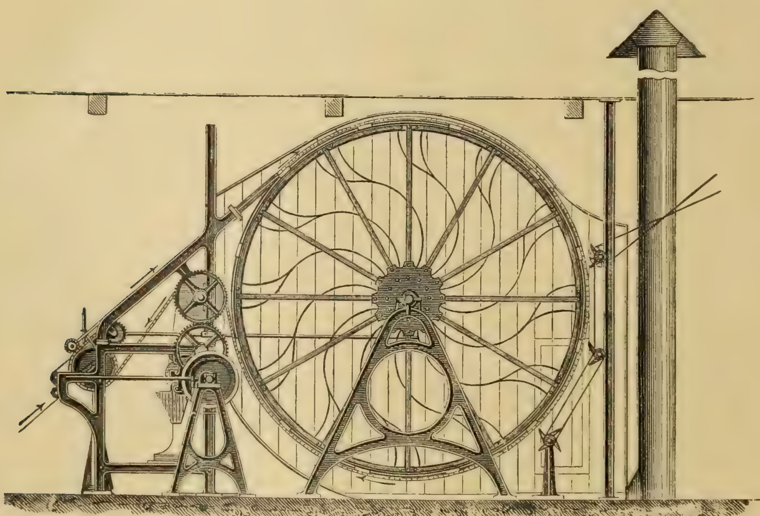

Fig. 36. Circular stenter with needles.

been constructed, a type of which is given fig. 36, page 152.

The circumference of the large drum is formed of steam chests, connected with each other, and which receive the steam by the axis of the drum. On the outer side of the chests are fitted chains with pins or clips. This kind of stenter renders

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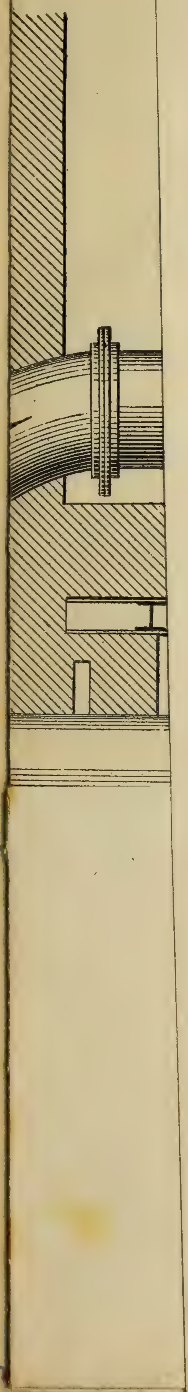

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some service, but it easily gets out of order on account of the great tension of the steam, which often causes leaks in the chests, which are difficult and expensive to repair. Another system of the same kind, but with hot air heating apparatus is that represented by fig. 37, page 152 A and fig. 38, page 152 B.

In front of the apparatus is the starch mangle; the piece may be passed first over a drying cylinder or directly on to the drum with clips; before going to the large drum the cloth is partially straightened by a workman as illustrated by hand; it is then again adjusted by a workwoman who at the same time looks after the clips and sees that the cloth enters regularly. Thin materials dry before leaving the large drum and then go directly to the folder. Should the cloth not be sufficiently dry it is passed over a third drum, placed below the large stenter drum, where the drying process is finished, after which it passes to the plaiter down.

Fig. 38, page 152 B, represents the heating apparatus. We have given two drawings of the stenter, which render further explanations unnecessary.

There are other systems of circular continuous stenters, but they are nearly all similar to those already described. These kinds of stenters are now seldom used, the horizontal continuous ones with cylinders at both ends being preferred.

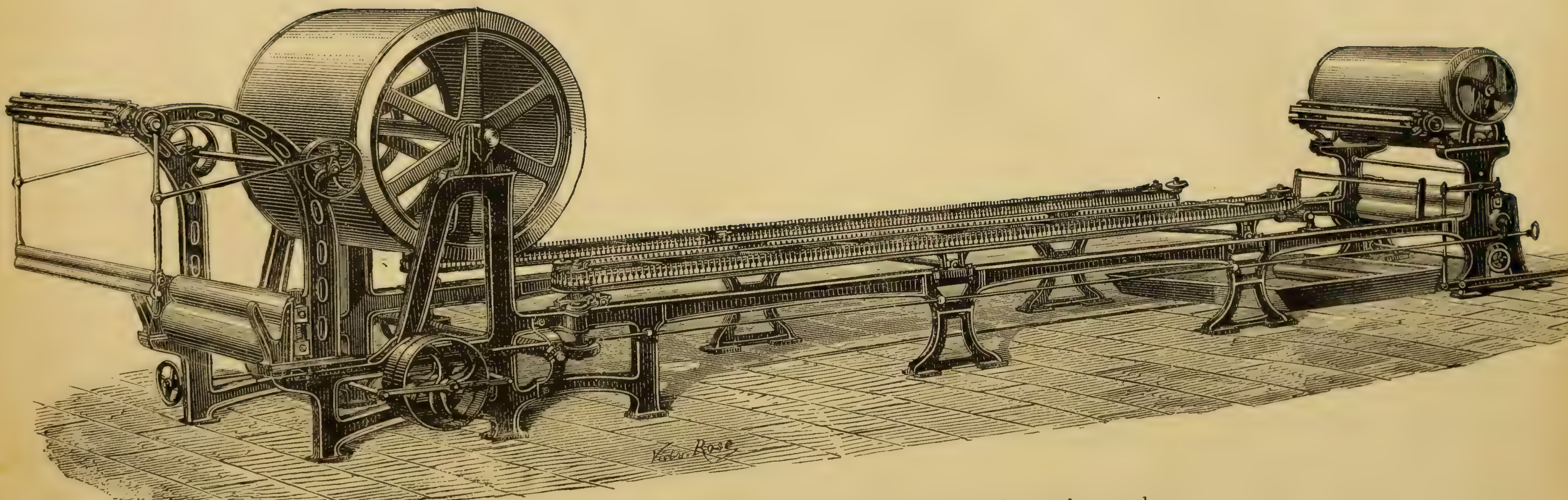
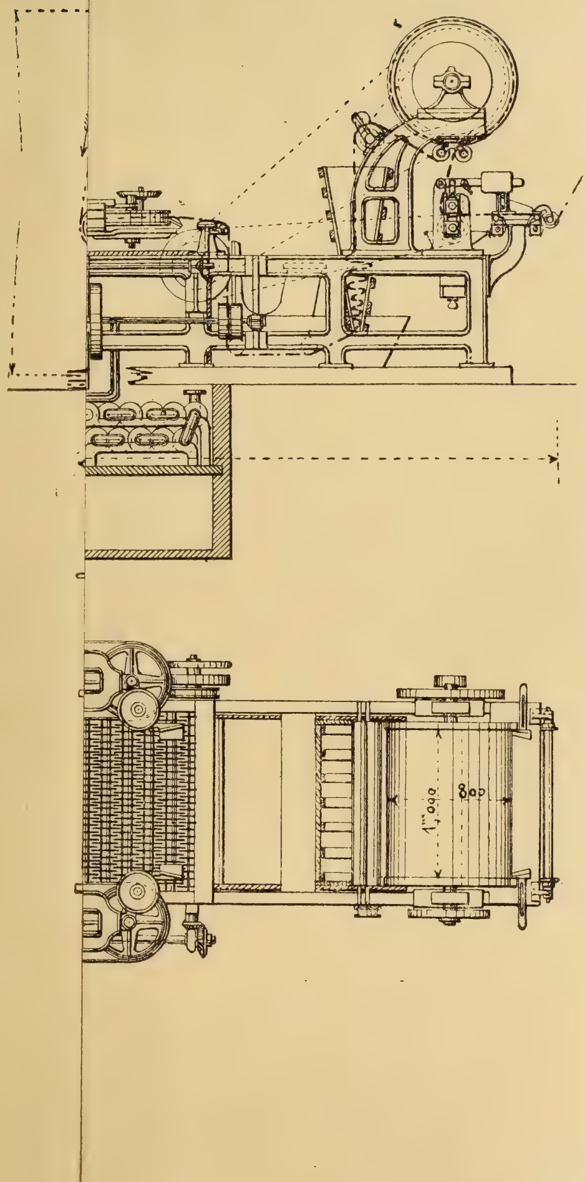


Fig. 39. Clip stenter with two drying cylinders combined with starch mangle.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A stenter with which we can starch or finish in every possible manner — (with ordinary mangle, on one side only, with heavy or ordinary size) is that illustrated fig. 39, page 154. It consists of a starch mangle arranged for all kinds of sizes, a cylinder is fixed above which partially dries the cloth; this is then plaited in a receptacle placed between the mangle and the stenter, and passes hence underneath a flooring where a workman is seated who guides it forward, towards a sort of table whence it is fastened to the clips; the piece is dried by degrees as it passes through the stenter, according to its speed, and lastly passes over another cylinder which completes the drying.

The drying is done by means of steam chests or of hot air introduced by a ventilator as in the stenters fig. 34, 35 and 37, pages 150 A, 150 A and 152 A, or again by means of gilled steam pipes, which we shall describe in another system of continuous stenters with regulating and vibrating motion.

If the piece already placed on the stenter be not sufficiently straightened it will sometimes form a curve in the middle either towards the entrance, or delivery side of the machine. An arrangement of pedals is then employed, which press on the fabric and by the degree of their pressure the material is pushed forward or held back as required and the fabric thus set even and square. It is easily understood that, if a certain pressure is given to the stuff when wet, the thread

of the woof will be stretched in the width, and it will consequently be easier to put the threads straight. It follows from what has been said that the manner of entering the goods on the stenter is most important. Indeed it is important to notice in entering the goods, the direction of the convexity of the curve formed in the woof, and to keep it towards the delivery end of the machine. In this manner the tension can be lessened by pressing on the middle of the piece; if on the contrary the convexity is towards the entrance of the piece, the selvages must be pushed forward which is neither easy nor adequate, for it is impossible to go beyond a certain limit of tension. We repeat therefore it is essential to watch, that at the entrance of the piece into the stenter, the convexity of the weft be directed towards the delivery end.

Most of the systems already examined dry by contact and without breaking the finish. One of the essential conditions to obtain a good »*feel*« is to dry the stuff without contact; this result has been obtained by shortening the stenter, placing a drum in front and a second one at the delivery end. In this way the thread is partly dry before the regulating commences but not too dry for this operation. When this has been effected, the thread recovers its roundness, the size, if we may use this expression, having coagulated, the drying is completed on the drum without greatly

injuring the thread. The main point is that the size should be fixed or set during its passage over the stenter, for were it otherwise the thread might lose its form, whilst completing its desiccation on the last drum.

The drum at the delivery end has another object: if a fabric has been starched and it is not completely dry, the drum completes the desiccation. If the fabric is completely dry, the last drum can be filled with cold water, which refreshes the goods and considerably facilitates the moistening.

Among the improved apparatuses of this system we must mention the new stenter by *Welter* and the hot air stenter by *Dessau-Cottbus*. (See Bulletin de la Société Industrielle de Mulhouse, 1884, page 406 and following.)

These two stenters having a certain resemblance we shall only describe the former which is complete with vibrating motion etc.

The new apparatus by *Welter* is composed of a continuous stenter with a drum in front and behind. A mangle is placed below the first drum employed to »set« the starch, so that immediately after the entrance of the goods into the clips the drying takes place rapidly. The opening and closing of the clip holders is effected by an arrangement of convergent screws worked by means of hand wheels. A longitudinal shaft and bevel wheels, placed at fixed distances enable the ope-

ration to be done rapidly and equally throughout the whole length of the stenter. The principal heating takes place by a system of gilled pipes, placed longitudinally side by side. The last cylinder, that is the one preceding the batching roller or the plaiter down, is especially intended for the drying of the selvages, which do not dry so easily in the clips, as in the needles. This cylinder, as we have already said, may be used for cooling as well as for completely drying the cloth.

This stenter does not differ essentially from those already reviewed, but what especially distinguishes it is:

1. The partial regulating, which takes place during the working of the chains. An eccentric communicates alternatively to one of the chains a slow or accelerated movement, which can be regulated at will. This variation of speed is repeated regularly a certain number of times during the passage of the tissue, and communicates to one of the clip holders a rapid movement, whilst the chain on the opposite side moves slowly and vice-versa; this causes the vibrating motion, which although not complete, is more than sufficient to give excellent results.

2. The system of heating apparatus, instead of being placed crosswise, is fixed lengthwise in order to reduce to a minimum the circuits of steam and consequently the condensation. The exhaust-steam and the condensed water supply a set of

gilled pipes, superposed and placed lower down at the entrance of the stenter. This set of pipes furnishes a special ventilator, (producing about 500 met. □′ of air a minute) with hot air, the temperature of which by this ventilator can rise to 70° centig. The super-heated air is forced through the cloth and gives it a supple and agreeable feel, it rounds the thread, which is not in contact with any metallic surface and considerably increases the production.

This stenter can stretch, dry and finish in 10 hrs uninterrupted work about 10,000 metres of starched cotton goods, 87 to 90 centim. wide and weighing in the grey 10 kgs. per 100 met. If the cloth is heavier, the production is less, and inversely — greater with light goods. All the systems of stenters which have been described are so fitted up, that the fabrics are completely dried on the last drum; they may then be rolled or folded, or even moistened immediately on leaving the stenter: but this method of moistening appears to us illogical and at any rate insufficient. The piece being much too hot the water vaporizes rapidly, and has not the time to soften the size, especially to soften it equally. Another method, though insufficient, is, when the fabric leaves the last drum, to inject a mixture of air and cold water; the air cools and the water moistens. This mode is preferable to the injection obtained by a steam pipe alone.

These are the different systems of stenters employed at the present day for the finishing ot cotton goods. There are many other similar or modified ones, such as the stenters by *Herzog*, *Force* and *Renwick*, *Hild*, *Brewer* etc., but they are of little interest to us, as they are intended specially for other goods than cotton, and besides work under quite different conditions. (For these different apparatuses, see »*Die Appretur der Gewebe*« by *Grothe* p. 560 and 681.)

METHODS AND DEVICES FOR FASTENING THE CLOTH ON THE STENTERS.

The means employed for holding the fabric on the stenters are very varied, and depend on the nature of the stenter itself. Formerly only fixed stenters were used, the origin of which it is difficult to state. The pieces were fastened by means of needles or pins fitted up in different ways; one of the simplest systems consisted in putting needle points on little longitudinal pieces of hard wood, and fixing the latter on the sides of the stenter by means of a screw; plates of fusible metal, into which the needles were cast, were and are still used. With this method, the good needles can be easily removed and separated from the imperfect ones. The fusion, which takes place at a comparatively low temperature,

does not affect the temper of the steel and the good needles can be used again; the plates generally used are of copper or bronze. The needles are sometimes fastened into thick straps, but this method has serious drawbacks; the needles very soon become bent and drag the leather out of shape, and this irregularity gives a disagreeable appearance to the goods. Besides, a strap which has served several times does not hold the needles sufficiently fast and if the needles are always put into the same holes they enlarge them, if put into new holes close to the former ones they weaken the leather and this irregular arrangement takes away from the fabric the neat and orderly appearance that it has generally with the pins well fixed.

So long as fixed stenters only were used the buyer paid little or no attention to the question of the needles, but when the continuous stenter came into use, the methods which did not fasten the stuff securely enough, had to be changed, and it was then that clips were introduced. A great dislike was taken to this system because it left no traces or appeared not to do so, and the buyer thought that not finding the marks of the needles in the fabric, it had not been tentered. Now this mark is no guarantee for there are certain cylinders constructed with pins or needles and yet do not tenter longitudinally or much less give the elastic finish, whereas a fabric well tentered

on any apparatus, whether fixed or continuous, with well-fitted clips will leave no trace on the fabric. The buyers gradually looked at this question more credulously and were convinced that it was not absolutely indispensable for the selvages to be perforated as a guarantee that the fabric was tentered. They then took to examining the thread, pattern and general appearance of the goods, which certainly indicate much better than the marks of the pins whether the cloth has been well treated or not. It is only by a close and serious examination of the final results that a just appreciation of the value of the methods employed can be given, therefore in commerce at the present day, the marks left by the pins are not in favour; it often happens that by too great a tension given to the stenters, the selvage is deteriorated. This accident also happens with the clips, but not so easily as with the pins although the clips, which act on 10 or 15 centim. at once, may injure the fabric, but the accident no sooner happens than it can be remedied by the workman, whilst the pin, which only acts at intervals of 2 centim. at the most (in general there are from 4 to 7 pins to every 5 centim.) can spoil the fabric in two ways — in the width, when the piece is too much stretched or in the intervals between two widths when the pin plates are wrongly distributed. We shall see how these accidents occur. In the first case the pins make large holes,

which, in woollen goods — a very elastic tissue, close up, but which in cotton fabrics remain. In the second case the piece being badly stretched it will curl up; this may also happen with clips, but it is produced in the interval between two consecutive clips and much depends upon the good construction of the stenter. Everything considered, in our opinion the use of the clips will prevail over that of the pins as being much simpler and less delicate.

The best system of stenters is still far from being perfect, especially as regards the »elastic« finish. In the stenter with needles the action of regulating or vibrating motion, takes place from one point or from one needle to the other, it follows that on the width of the stuff the diagonal of action advances to the real line which represents the fabric, whilst with the clips, which are from 15 to 20 centim. long, the line of action is much stronger, with the same movement, and in the space between the two clips a frayed appearance is often produced.

The use of pins dates nearly a century back, but it was only in 1831, that an Englishman *S. Morand* patented thn first endless chain. In the first machine that he constructed, as long as the fabric was not dried, a convergent movement was given to the chains; when once the heat had reacted on the size, the chains were paralleled and thus maintained the regularity in the width

of the fabric. The same inventor had also the idea of applying cylindrical brushes to facilitate the setting in motion of the stenters. Other inventors such as *Whitely*, *Beu* and *Hilger* introduced new modifications without succeeding in producing irreproachable chains. One of the principal drawbacks was: when two links turned on the pulley, which carried back the chain to the entrance of the machine, the cloth was too much stretched and tore; whereas, on the contrary, with the chain of return stenters, the cloth formed a kind of knot. It was only after numerous trials that Mr. *Paul Heilmann* discovered the means of avoiding this inconvenience. The lower part of the needles must be absolutely on the line corresponding to the central axis of the chain links; each movement of the chain describes an arc with the connecting pin of the chain link as centre, and the branch of the stenter as radius, so that whatever may be the position of the links, the distances of the *lower part* of the pins remain equal.

Fig. 41, page 165, shows at point M the two links a and b with outside movement.

Fig. 42, page 165, shows the same chain with the movement inwards. It is seen that the lower part of the pins is exactly at the same distance in both positions, but the stuff must be firmly pinned, for if it is badly attached to the upper part of the needles, there will be rents. The construction of the chain must be such that

a certain space is left between the links so as to allow for the working round the pin or fastening point between a and b.

Amongst the other systems with needles which have a great resemblance to each other, we will only

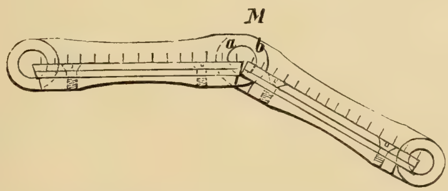


Fig. 41. Chain links of pin stenters outside motion.

mention the modifications due to *Thomas*, *Thomson*, *Société d'Anhalt*, *Berlin*. See *Appretur der Gewebe* by *Grothe* p. 558 and following pages.

As we have already said it is not the needle itself which causes the difficulty of the setting in motion, but the disposition of the needle on the

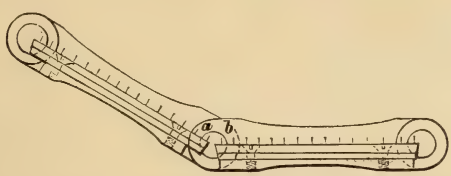


Fig. 42. Chain links of pin stenters inside motion.

chain, which should be continuous and adapt itself to all the mechanical requirements of the goods to be finished. Numerous kinds of chains have been coustructed. In some, the needles are placed slanting so as to keep back the stuff and facilitate

the working of the stenter, as in the chain of the machines of *Anhalt-Berlin*; in others the chain is formed of one single piece, either in steel, copper or leather, like those of *Scheurer*, *Rott and Co. of Thann*, or in india-rubber as *W. Laing* proposed. Chains are also made in hard wood into which the needles are fitted, or in metallic plates into which the needles are soldered, but the system in wood has serious drawbacks. The heat warps it, and causes it to lose its shape, thus giving great irregularity in the manufacture.

Upon the whole it is very difficult to specify which is the best system of needles to be employed: for thin fabrics a leather chain, with the needles fastened directly into it, can render good service whilst for thick goods recourse must be had to the chains provided with metallic plates, as they give the needles more resistance although they are more liable to break and consequently necessitate more repairs.

As the system of stenters with needles leaves traces, and in some cases causes spots (steel needles in contact with light colours containing tannin for instance) attempts were made to replace the pin and the result is a clamp or clip.

This system represented in fig. 43, page 167, is one of the simplest and gives a general idea of the clip most in use. In A is figured the framing or rail, which in our drawing is curvilinear,

but it may also be straight. C is the clip properly so called, from 5 to 10 and even 20 centim. long — in d it makes a bend on which, by means of a mechanism not represented in the drawing presses another metallic piece, intended to raise it from the rail, that is to say to open it. As soon as the rod no longer touches the part A the clip forced by the action of the spring b resumes its

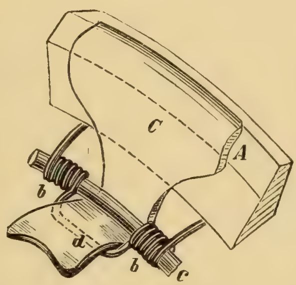


Fig. 43. Clip for continuous stenter.

normal position and presses against the side of the rail, thus fastening the cloth.

The greater number of the systems of clips are based on this principle.

In other constructions as in the clip of *Gebauer*, the action of the lever has been utilized; instead of a frame or rail we find a series of metallic pieces in the form of a bent finger against which is fixed another similar piece, which, by contact,

represents pretty correctly the fastening obtained by pressing the thumb against the forefinger, the forefinger represents the fixed part against which the part representing the thumb strikes, which part instead of being provided with a spring has on the other side of the connecting point a prolongation the weight of which acts as a lever and consequently tends to promote the bringing together

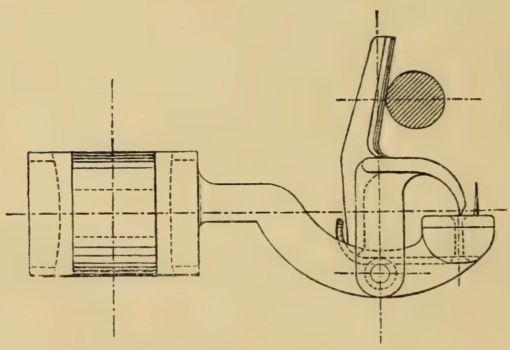


Fig. 44. A section of the clip combined with needle closed.

of the two extremities. A rod passes under the end of the piece, representing the thumb and the opening of the forefinger; as soon as this rod is removed from the end of the thumb the latter falls by its own weight on the alternate part and grips the cloth.

The diverse systems of clips which are all more or less connected with the two kinds mentioned are due to Mr. *Jahr*, (German Patent

Nr. 12.200), *Farmer* (English Patent 1872, Nr. 1819), *Brewer* (English Patent 1873, Nr. 1631), *Hertzog*, *Welter*, *Delharpe*, *Pasquier*, *Lacassaigne*, (Bulletin de la Société industrielle de Rouen 1877) and we consider it unnecessary to give details of them.

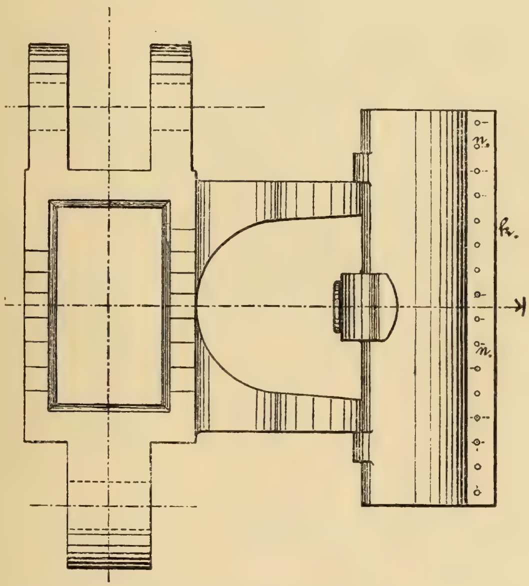


Fig. 45. Clip closed combined with needle; plan.

A manufacturer of Zittau (Saxony) *Kiesler* has recently combined the needle and the clip. In his new apparatus the fabric cannot escape from the needle, and as the clip helps to hold the cloth the needles mark it less.

The fig. Nr. 44, page 168, Nr. 45, page 169, Nr. 46, p. 170 dispense with other explanations. (1)

The drawing fig. 44, page 168, represents a section of the closed clip. In k is a flat part on which the clip passes and holds the stuff already entered on the needle at n.

Certain modifications have been introduced in the construction of the chains, which enable a stenter

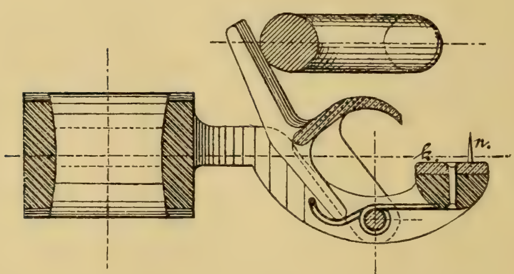


Fig. 46. Clip combined with needle, open.

with needles to be easily transformed into a stenter with clips and vice-versa. The machine *Welter* described page 154 is of this kind.

These different systems of clips are only used in conjunction with stenters. For stretching or widening goods generally entirely different means are adopted, which we shall take up in the following chapter.

(1) These figures are extracted from the *Leipziger Textil-Wochenschrift.*

EXPANDERS AND APPARATUSES FOR WIDENING AND „BREAKING“ FABRICS.

It is well known that in bleaching and dyeing operations the width of cotton fabrics diminishes considerably on account of the twisting, which the pieces undergo in order to make them circulate in the different apparatuses. These causes as well as the elongating and the drying, partially contract and shrivel the weft; the last defect is however scarcely perceptible to the naked eye. It may also be said with regard to the width, that the shrinkage is due to the development of an infinity of little creases; the proof of this is that the cloth can be easily stretched by hand to the same width it had, on leaving the loom.

This shrinkage is remedied by means of different apparatuses — some, called expanders and stretching machines have for special aim, as their name indicates, the stretching of the piece in the direction of the weft and bringing it back to its maximum width. Others, which are also intended to stretch the fabric, but which at the same time remove the creases, break the stiffness and so widen the piece as to make it recover in width what preceding manipulations caused it to lose.

These apparatuses play an important part, for it is well to remark that in cotton goods it is scarcely possible to give to finished

pieces the width of the unbleached cloth. With white goods this can be rectified and brought to the width of the unbleached calico within 3·4%, but in printed goods which undergo, besides the bleaching operations, numerous manipulations, from 6 to 9% of the primitive width is almost always lost in spite of the most rational and best adapted use of the wideners and even when working under exceptional conditions.

An unbleached calico of ordinary pick and 90 centimet. wide, otherwise called 3/4, loses nearly 10% even 12% in the bleaching; the printing, dyeing etc. make it lose from 1 to 2% so that even in the very best conditions printed goods of 90 centim. wide, in the grey, would not be more than 82 or 83 centim. when finished, admitting that the work had been done in the best manner possible. If then the expanders are not used, the principal object of which is to remedy this drawback, it may happen that the starched and finished piecc be only 78 or even 76 centim. wide. The weaving has a certain influence, by means of temples manufacturers endeavour to give the greatest width possible to the grey cloth. As this width is artificial a simple passage through water often makes the goods shrink several centimetres; the question of stretching being important, we will examine in detail the numerous apparatuses invented for this purpose.

A piece, dry or wet, simply stretched without a proper support never has its real width. If for instance, it is passed over a wooden bar simple rubbing will remove the creases and render it smoother; if grooves are made transversal relatively to the bar, and if longitudinal relatively to the fabric, the latter will be carried along by these grooves. Place this bar obliquely and it will act as a stretcher; the simplest method consists of a wooden or metal bar with flutes starting from the middle, and going on the left side from right to left, and on the right side from left to right. The fabric coming against this bar is spread by the flutes and stretches. This is usually called a »fishback« or scrimp-rail.

The first improvement, that this apparatus underwent, was the following: instead of fluting a simple bar grooves were cut on a cylinder which turned in the same direction as the cloth, the grooves are in the form of a screw and are parallel or better still spiral going from the middle of the piece towards the selvages. This stretcher turns with a greater speed than the fabric and at least the third of its circumference should be in contact with the stuff to act efficaciously — sometimes it only acts by impulse.

These kinds of stretchers or spreaders are especially employed in batching or rolling up machines and behind printing machines and generally

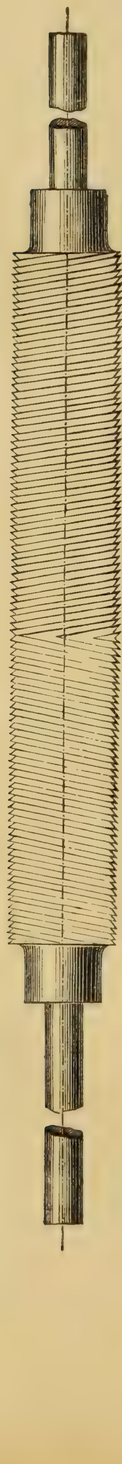


Fig. 47. Fluted (screw) expanding roller.

in all machines working with dry fabrics. (See fig. 47, page 174.)

When the cloth is wet the following stretcher is used: two cones forming an angle of about 140° are placed, relatively to the weft of the tissue in such a manner that, the weft being considered as a straight line, each of the cones forms with it an angle of 20°, the centre of which represents the middle of the cloth as well as the apex of the junction of the cones.

The greatest diameter of each cone measures from 8 to 9 centim. and the smallest from 3 to 4; the length of each cone is about 50 centim. In some, the flutes are perpendicular to the axle of the cone, and in others they are spiral going from the centre of the expander to the edges. This apparatus, which has gained favour during the last few years, was invented in Normandy about 1825, by a foreman, named *Coyot* — whence the name of »Coyots« given to these expan-

ders at the present day in the manufactories of Rouen. This kind of apparatus renders immense services for stretching dry as well as damp fabrics, but with damp goods its action is more efficacious. Fig. 48, page 176, shows an apparatus of this kind, perfected and fitted to a drying machine.

In 1829 an Englishman named *John Jones*, invented a stretcher constructed in the following manner: three fixed pulleys are mounted on an axle, the one in the centre is perpendicular, the two others at the extremity are placed in an oblique position. In the circumference of these pulleys are enclosed sectors, parallel to the axis; they are movable and work by means of grooves placed underneath. When the axle, provided with a pulley, is put in motion, the sectors are carried along and forced to describe the ellipsis, formed by the pulleys placed in a slanting position. These sectional expanding pulleys in revolving arrive at a maximum distance apart and then at a minimum distance apart. — In using this stretcher, which, from what we have just seen, only acts on the half of its circumference, it must be placed so that the piece enters at the *minimum* point of the opening of the sectors, that is, at the point where the extreme pulleys come nearest together, and goes out at the *maximum* point, that is the point where the pulleys are farthest apart.

Another stretcher, based on the same principle, but the movement of which is modified, is

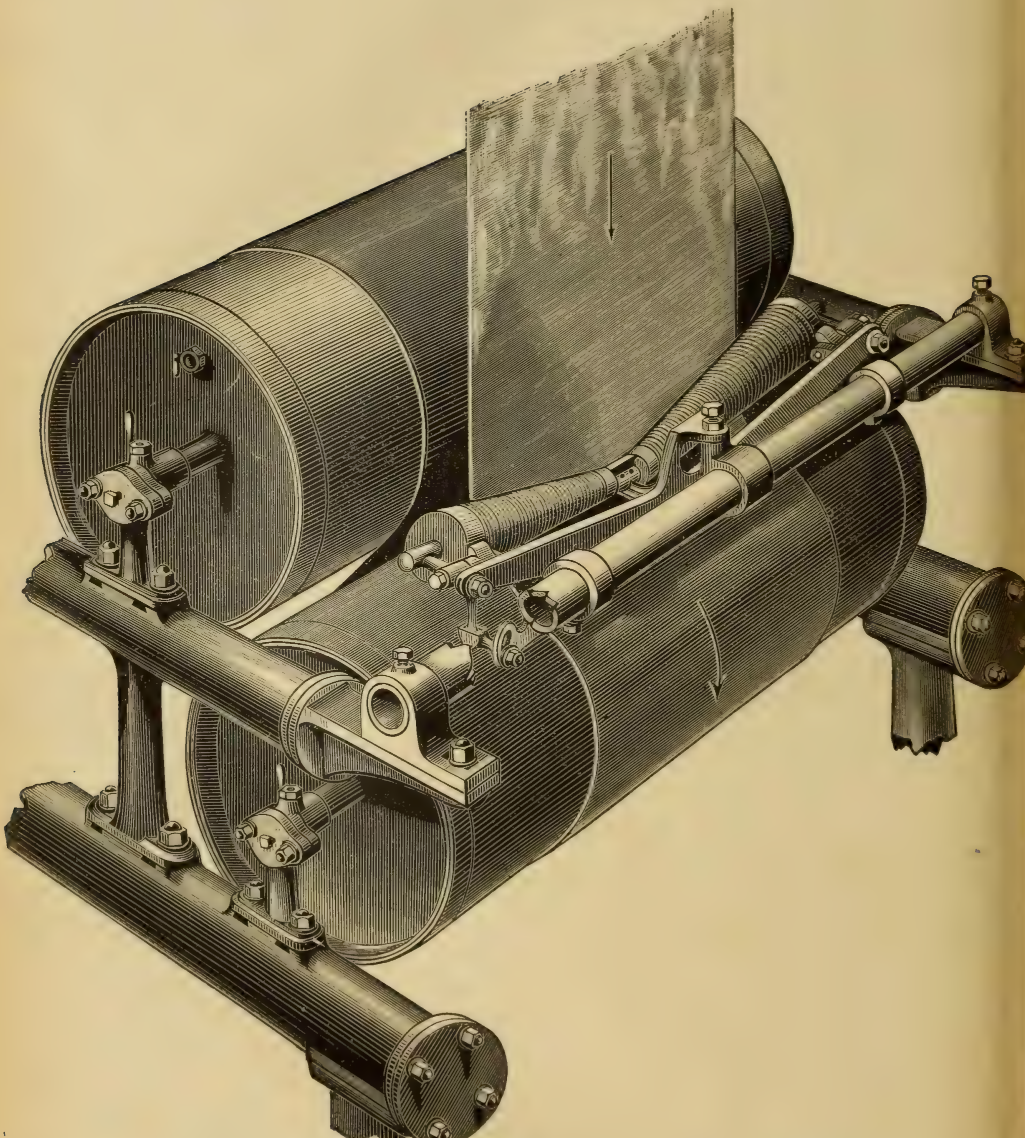


Fig. 48. Conical expanding rollers as applied to a cylinder drying machine.

that represented fig. 49, page 178. Plate 16, page 107, shews its position between the starching machine and the drums.

Instead of having a movable axle, we have here a fixed one, on which two movable eccentrics are fitted. They are united at the top by a screw which permits the expanding to be modified by regulating the working of the sectors. If the eccentrics are placed perpendicularly to the axle, the sectors will turn simply like the wooden staves of a wince, but if by the screw placed at the top, we displace the eccentrics, a to and fro motion will be given to the sectors. The piece, which rubs on the surface of the sectors, promotes this movement, and to facilitate the adherence of the cloth, the sectors are jagged like a saw.

This stretcher is excellent in finishing machines, and is one of those most generally used at the present day. *Hesford's* machine is very similar to the preceding one.

It is likewise (see fig. 50 and 51, page 179) composed of an axle, on which eccentrics are fixed. Ten sectors form the circumference; in fig. 51 letters are seen which serve as a guide and facilitate the setting in proper position of each sector. As in the preceding stretching roller the machine is worked by the friction of the fabric; the ribs, instead of being slanting are straight, and therefore, according to the inventor should give a better hold to the tissue.

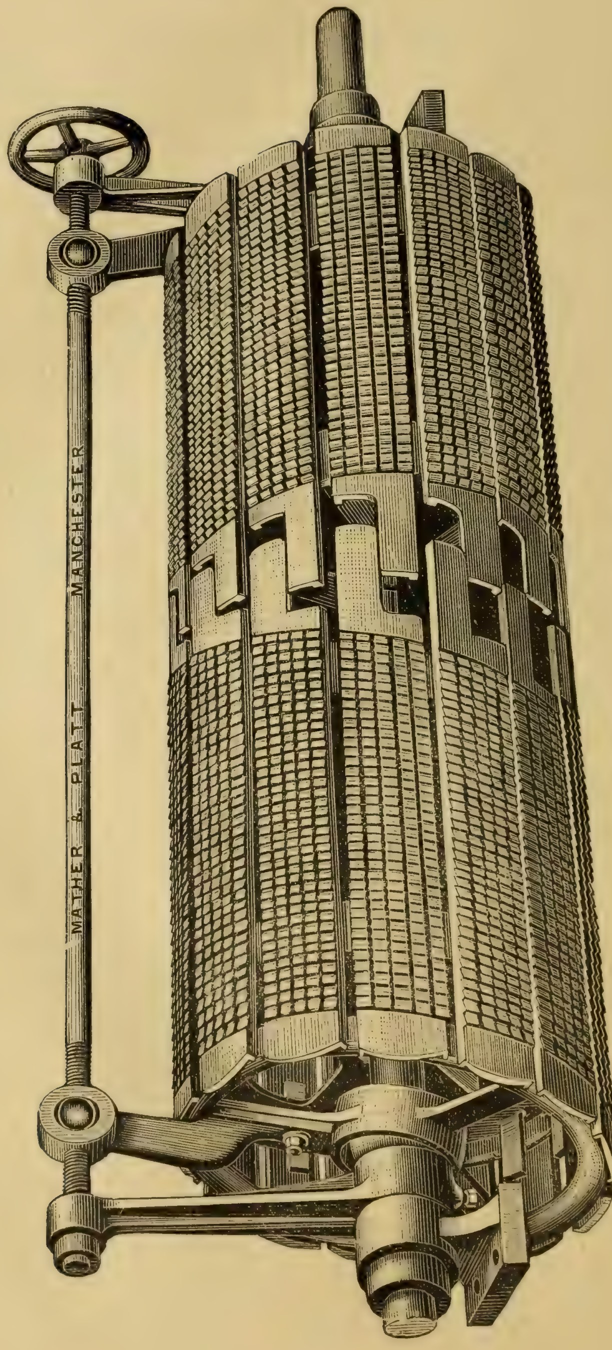


Fig. 49. Sectional expanding roller.

Greenwood has modified this apparatus by enlarging it in the middle, so that the line of contact, instead of being straight, represents an arc of a circle.

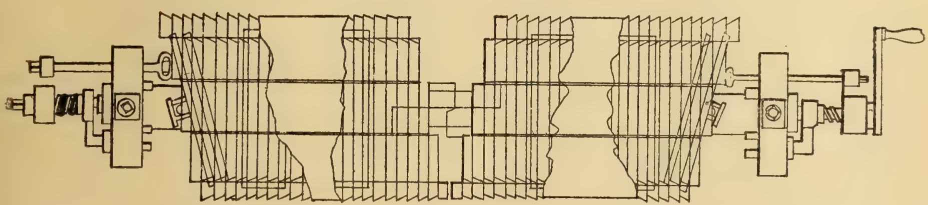


Fig. 50. Hesford's expanding roller, front view.

An excellent stretching apparatus is that of the American *Luther* (patented in 1877 Nr. 156.643, see fig. 53, page 180). The construction of it is very complicated and consequently keeping it in

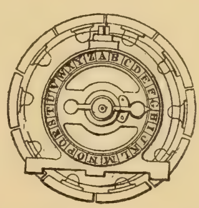


Fig. 51. Hesford's expanding roller, end view.

order demands more care. It consists of sectors n, n, movable on axles o.

The pieces constituting the sectors are fastened together, the extremities have a sort of head,

which is fitted into the piece d, e, which piece is in connection with the piece l. The axle a, b, being fixed, the eccentrics c, c, are turned by the friction of the cloth, and this movement promotes the extension of the fabric. This apparatus has the drawback of being very expensive and complicated, of not being easily oiled, and it requires such force as precludes its use for thin goods, its action is all the more energetic and effective for strong goods.

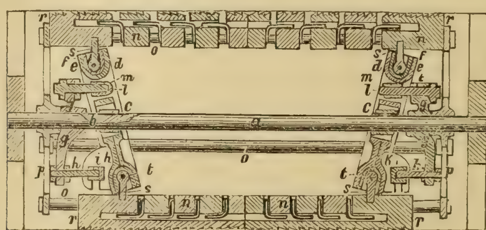


Fig. 53. Luther's stretcher.

The greater number of expanding rollers described have undergone other modifications in the exterior parts, inasmuch as some have large sectors, others small ones, the direction of the grooves is changed, the shape of the flutes, their depth etc.; but of all the stretchers already mentioned, the one with sectors represented fig. 49, page 178, may be considered one of the most appropriate for finishers.

Among the other stretching apparatuses we must mention *Poole's*, patented in 1841; it is com-

posed of four pulleys a a′, e e′, which may be inclined according to the tension to be given, by means of the lever g and the screw f. The pul-

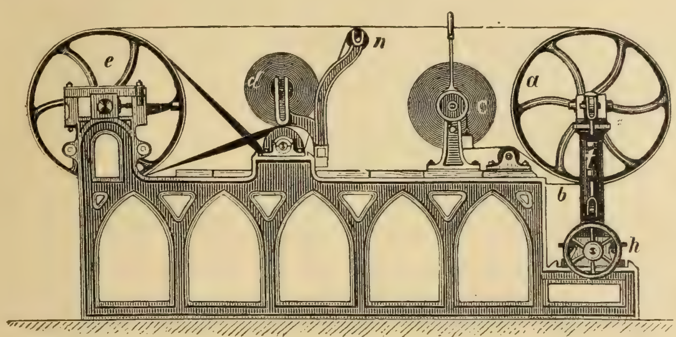


Fig. 54. Poole's stretching machine, side view, made by Jackson & Brother, Bolton.

leys from 6 to 10 centim. wide, were first of al provided with grooves, then with pins and lastly

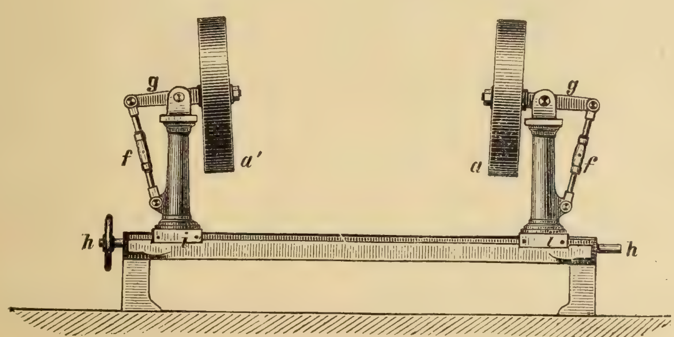


Fig. 55. Poole's stretching machine, front view.

with clips. The fabric rolled on C enters and is put in contact with the pulley a at the point b at the moment when the opening is the smallest;

the half-turn stretches to a certain width, the piece passes over a roller n and enters a second system similar to the first and represented in e, the cloth then undergoes a second stretching, and is batched on d. At the point b is a screw, which acts on the supports of the pulleys a and a′ and permits them to be regulated according to the widths to be treated.

Mather and *Platt* have constructed a machine, the principle of which is the same, but the contact takes place on 2 pulleys instead of 4: the pulleys are placed obliquely on the axle and are loose, so that the extreme widening is always at the same place. Underneath these pulleys are endless straps, which take the cloth at the entrance or at the minimum opening, to leave it at the maximum, when it has undergone the stretching process. As these pulleys have a large diameter, the action is all the more intense. (Fig. 52, page 184.)

This machine, all the details of which are not represented in the drawing, is especially applicable for light finishing, for, as it only operates on the dry tissue, it produces less than the preceding expanders. In the middle, pulleys with larger diameters have also been interposed, which in pressing on the fabric help to stretch it; these pulleys work with the stretching pulleys and by suitable regulations the fabric is undulated and thus a more equal stretch obtained: this arrangement is option-

al. The use of this machine in bleach works and the finishing of white goods offers, it appears,

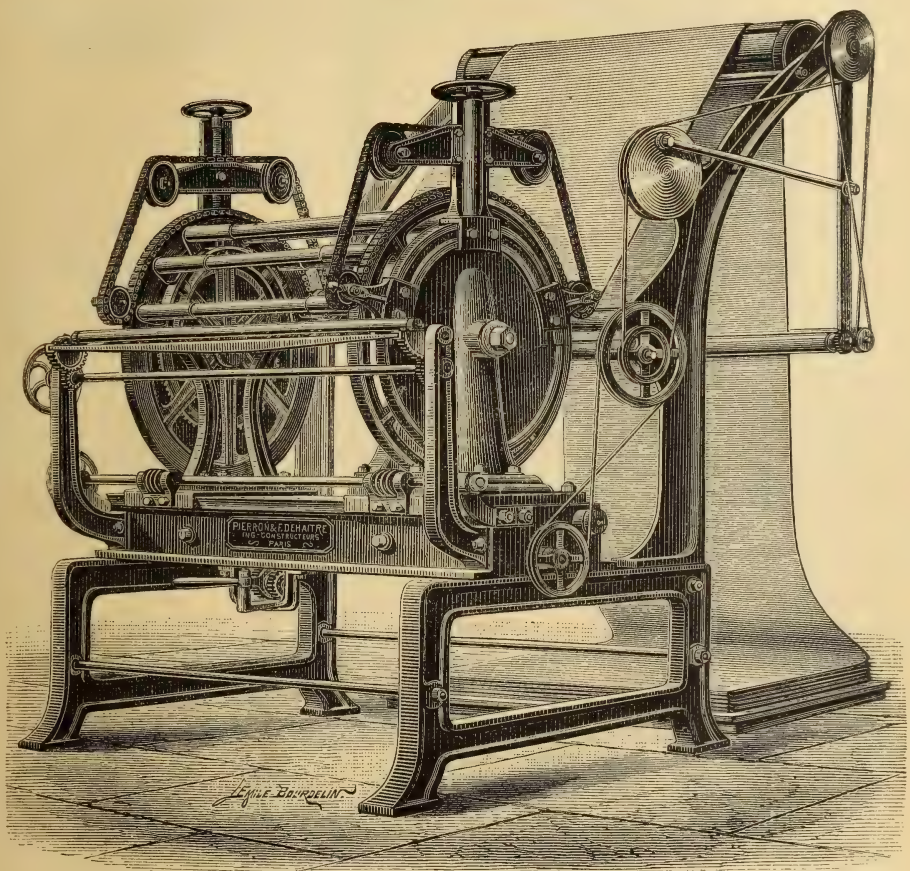


Fig. 56. Palmer's Stretching Apparatus.

considerable advantages as it stretches so regularly, that is affects the stiffening but very slightly and it will stretch as much as 110 yards a minute.

Various other machines have been constructed on the same principle by the *Cleveland Mach Works*,

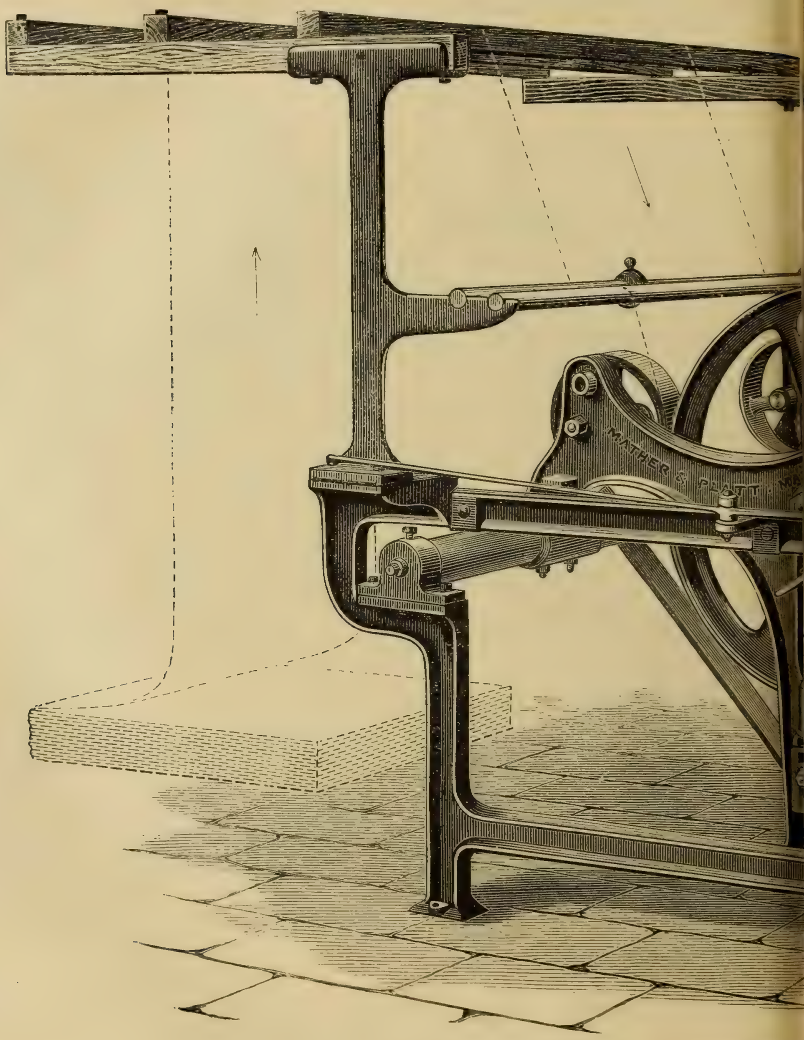
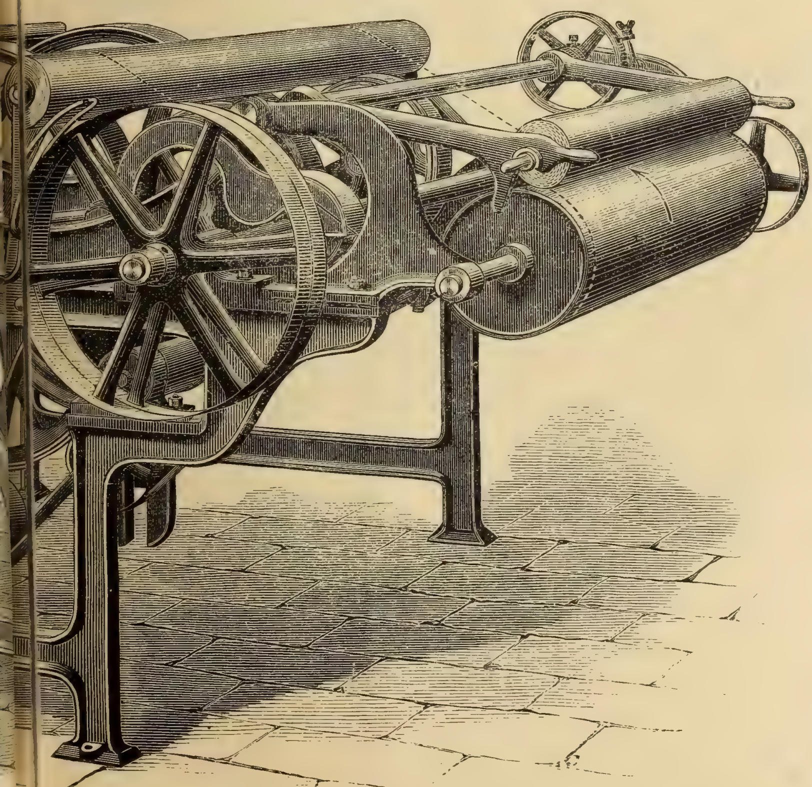


Fig. 52. Mather and P

Hartmann of Chemnitz, *Hirst* and *Michel* and *Gebauer*. The latter has fitted to his apparatus a kind of clamp

or clip, very ingeniously constructed and imitating perfectly the action of a person, stretching the cloth



.t retching machine.

by hand. We have already spoken of it in connection with clip stenters. (See page 167.)

Palmer of Middletown, one of the principal constructors of finishing machinery has modified the stretching apparatus in the following manner. Instead of an eccentric pulley he employs a pulley, placed normally on the axle. But above this pulley (there are two, one at each extremity of the

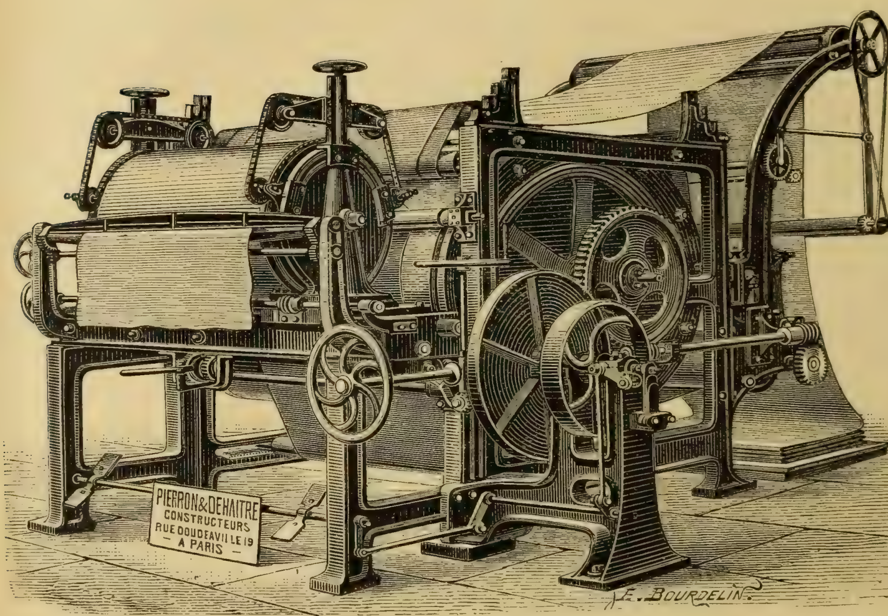
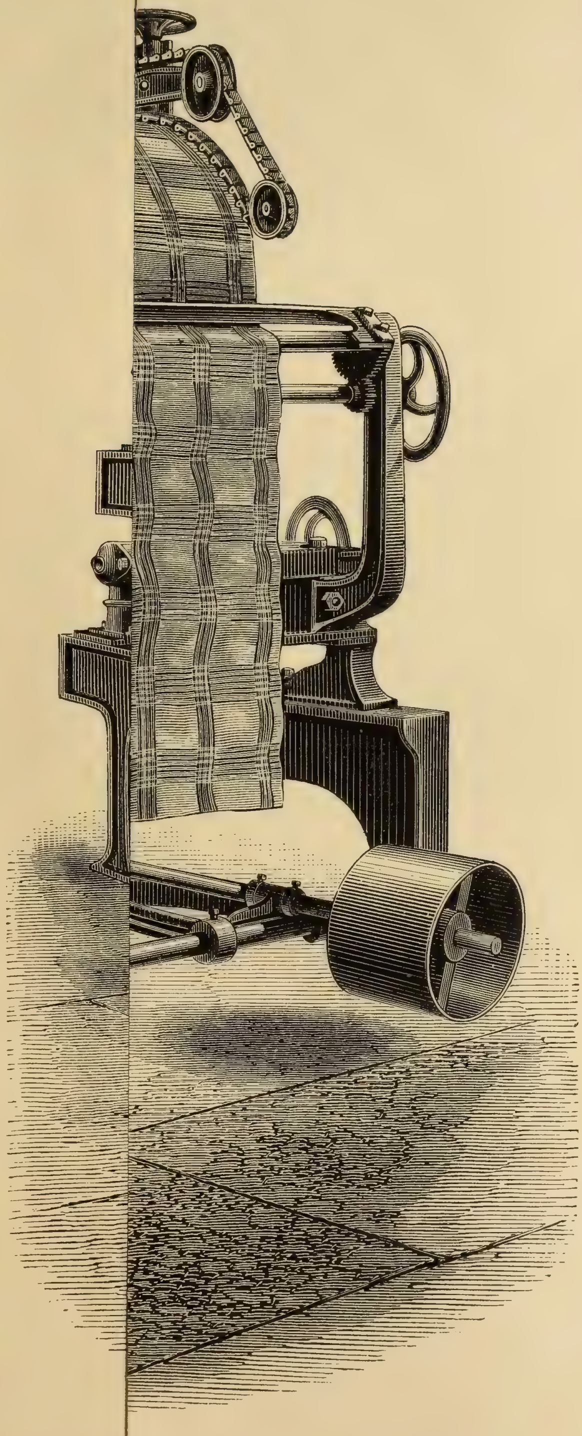


Fig. 57. Palmer's stretching apparatus combined with a drying cylinders.

axle, and acting in the opposite direction) is fixed an endless chain, placed diagonally to the pulley. This stretching apparatus has been combined with others. Fig. 57, page 186, represents it fitted to a drying cylinder; it is not very much used for cotton fabrics, but especially for woollens.



FOLDOUT

NOT

DIGITIZED

When checked goods, such as »oxfords«, ginghams, coarse printed cottons etc. are to be straightened and finished the Palmer expander is combined with an 8 cylinder drying machine. This apparatus is represented fig. 58, page 186B.

Another system of stretching apparatus is that of *Lacassaigne* (see Bulletin de la Société Industrielle de Rouen 1877, page 125). Its action is principally caused by the clips which act on the selvages.

In addition to these expanders we may also mention the apparatuses of *Marcadier*, *Devilder* and *Bosshardt*, all three based on the same principle. These machines work exactly in the same way as a workman who stretches a tissue by hand on a table. The cloth is held on both sides by the apparatus which works very regularly, according to the width to be given. With this last apparatus as many as 88 yards can be stretched in a minute. The keeping in repair is not expensive, it consists simply in replacing the little straps of the upper part, and this only every five or six months, even when in full work. (See *E. Lacroix*, Rapports sur l'Exposition universelle de Paris 1878. Rapport 29, page 410 and following ones.)

During the past few years special apparatuses have been used, not only intended for stretching the cloth but also for breaking the finish. Scarcely more than one type of this kind exists and the invention is due to Mr. *Paul Heilmann* (see Bulletin

de la Société Industrielle de Mulhouse 1868, p. 375) see fig. 59, page 188.

This apparatus is composed of two fluted cylinders R and R′ covered with india-rubber; at a and a′ are screws fixed on the axles m and m′ destined to give the necessary tension to the india-rubber covers; at E is a pressure screw, which gives more or less »nip« to the bowls;

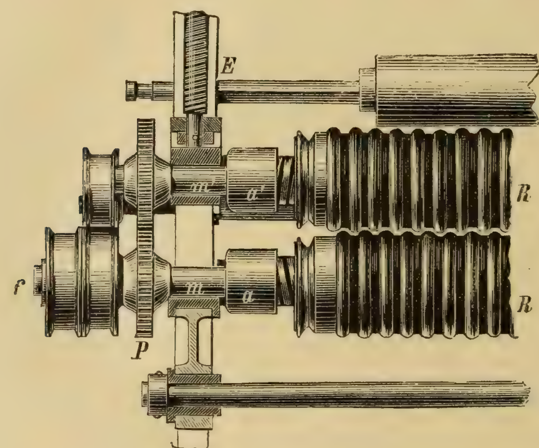


Fig. 59. Heilmann's stretcher.

the wheels P drive the two bowls simultaneously. The fabric in passing between is stretched by the action of the india-rubber; this apparatus is indispensable now-a-days in the finishing department; it is used as a stretcher and also for breaking the finish or stiffness.

In Normandy for some time past a little apparatus has been used, which has a certain

analogy to the preceding one and is very useful as a »breaking« machine. This apparatus is composed of grooved wooden rollers, working one in the other. These two rollers are not covered with india-rubber, therefore they cannot be used for stretching: they are only used for »breaking« the finish. The groove, instead of being perpendicular to the axle is slightly slanting, the slant beginning from the middle and going towards the extremities, whereas in the apparatus *Heilmann* the grooves are perpendicular to the axle of the cylinders.

Another apparatus ot this kind is *Welters*. It is very similar to the preceding one. (German patent Nr. 30.067.)

We cannot conclude our study of the various stretching apparatuses, without speaking of the machines for widening goods, that is which help to give the fabric its original width without stretching it. Although these machines are only of relative interest in finishing, we will mention those most employed.

After a piece has undergone a manipulation, in which it has been twisted, in order to dry it, it must either be passed over the »half-moon« a little apparatus from 80 to 100 centim. wide, in the shape of a crescent, or unfolded by hand. An apparatus has been invented, fulfilling the conditions necessary for the continuous drying of the piece and which at the same time untwists and

stretches it. This machine, represented fig. 60, page 190, is the invention of *Birch*, it is generally placed above the drying machine and requires a certain space, without which the »scutching« would

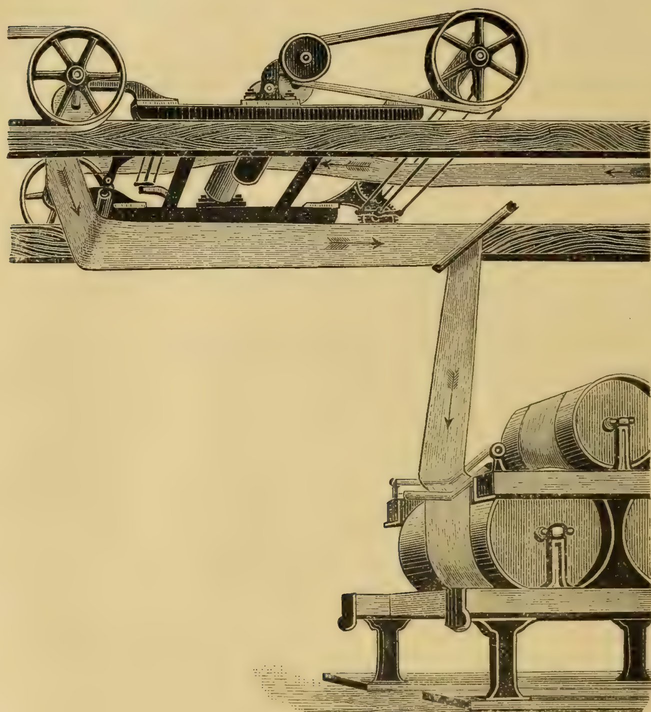


Fig. 60. Scutching apparatus, Birch.

not take place properly. The piece passes first between two kinds of beaters, then between two rollers provided with grooves, going from the centre to the extremities, and lastly it is opened and stretched by an automatic expander placed

before the drying cans. This apparatus is useful in the finishing of white goods which are starched immediately after the bleaching operations without being previously dried.

Our figure shews the fabric going directly on to the cylinder, but this course is not always followed: sometimes the bleached fabric is untwisted, passed through the water mangle, then through the starching machine and then to the drying machine.

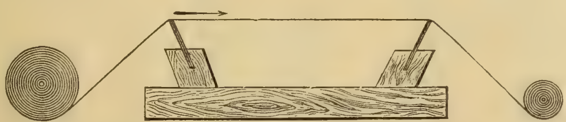


Fig. 61. Doctor »breaking« apparatus.

Another machine constructed for the same purpose is the chain opener by the same inventor. It is composed of two chains with movable rings, which are placed on two rollers or pulleys, one of which is fixed to the exterior rim in front of the drying cylinder and the other in the middle of the fabric, an analogous machine is placed on the opposite side. This chain works in the direction of the width of the goods and by rubbing on the fabric opens and stretches it. The line of rubbing corresponds to the weft of the material.

Among the methods employed for »breaking« the finish or stiffening, we may mention the following

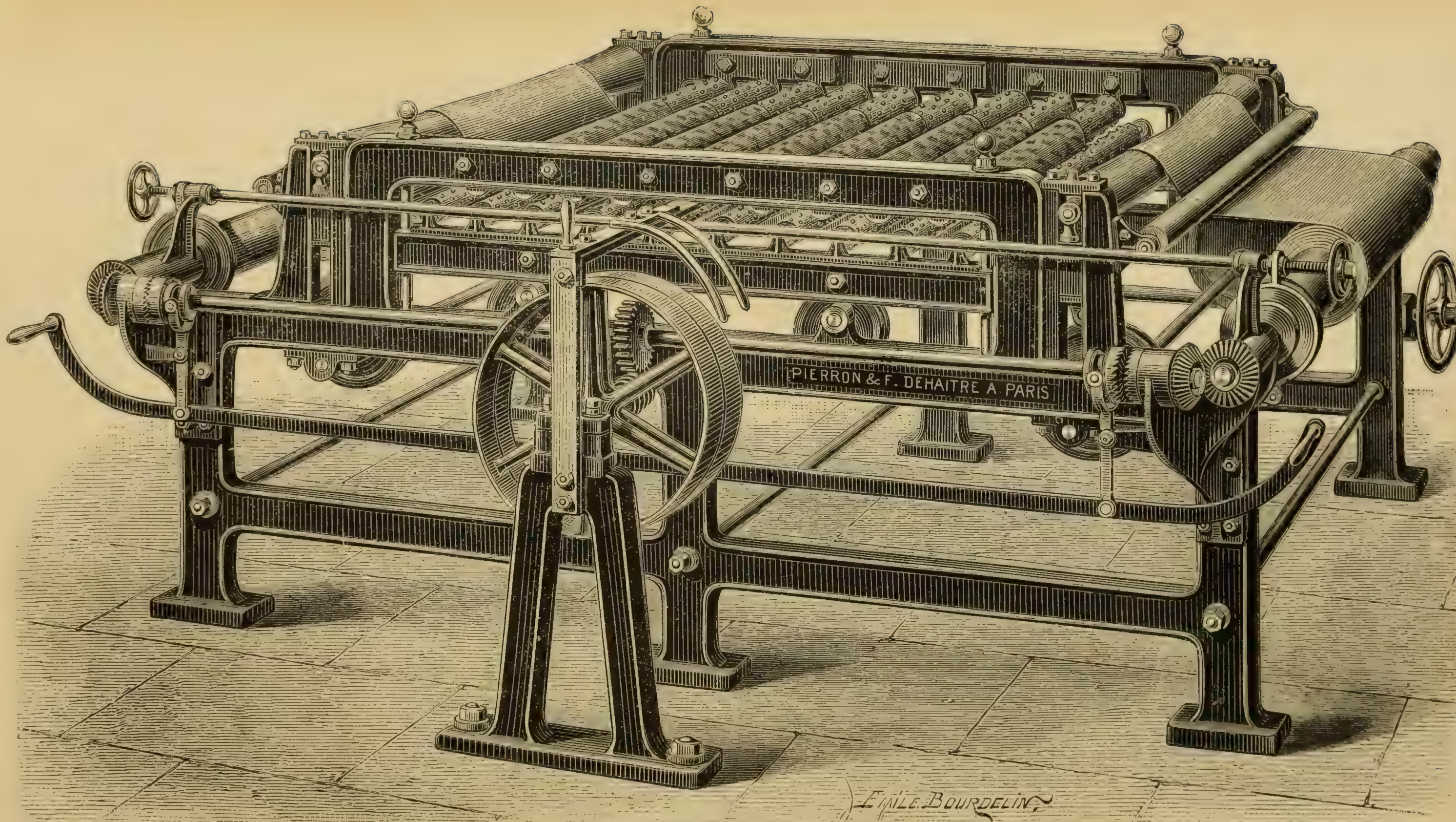


Fig. 62. Breaking machine Garnier.

little apparatus. It is composed of an ordinary frame, on which in the direction of the weft of the piece are placed two doctors. The doctors are rounded and are inclined to the fabric at angle of about 60^0. The piece traverses so that the right side, the side not stiffened, touches the doctor, the reverse side being above; these doctors thus break the stiffness by the tension from the taking up roller. This machine is especially used for weighted goods.

A very ingenious apparatus for »breaking« stiffened goods is *Garniers* fig. 62, page 192. It is composed of parallel frames, supporting all parts of the machine. In front and behind are two rollers, the fabric to be manipulated is placed on the roller at the entrance and in proportion as it undergoes the treatment from the machine it winds round the roller at the delivery end. It is the roller, round which the fabric is rolled at the entrance end, which is driven and by means of a brake applied to the other roller the resistance of the fabric, and consequently its tension in the machine, can be regulated. An ingenious arrangement allows either of these rollers to be worked at will, so that the fabric can be passed alternatively from one roller to the other and at each passage it undergoes the action of the breaking rollers.

The method of driving is by a special arrangement of gearing, the details of which are

of no interest as regards the working of the machine.

The fabric on leaving the roller on which it is placed, passes over the breaking cylinders, which constitute the principal element of the machine. The cylinders are of wood fitted on iron axles, they are furnished as experience has found to be best with ovoid headed nails, similar to those employed by upholsterers for furniture. Ten of these rollers, placed on the upper cross-bars of the frames have their axles fixed and turn freely in their bearings. A second series of ten rollers are mounted on a movable horizontal frame, which can be raised or lowered by eccentrics. By means of a handle working the endless screw the ten rollers of the movable horizontal frame can be brought between those mounted on the other frames.

It may be easily understood that the cloth which was at first straight, and which passed freely between the two rows of the »breaking« rollers would, when applied to the projections of these rollers, take an undulated form; it will be alternatively concaved or convexed in passing over the twently rollers, the nails of which are not always at the same places and thus the regular »breaking« over the whole surface is produced. (See *Batifois*, »Manuel du Teinturier« page 317 and following ones.)

The fabric on leaving the breaking cylinders passes over the stretching cones the apices of which are on the axle of the machine and the bases turned towards the frames.

The machine possesses two arrangements of stretching cones, each of which corresponds with one of the primitive rollers; the fabric is passed on either of these stretchers.

For light goods two passages may be sufficient, but on account of the great rapidity with which the operation is effectuated, it is preferable to increase the tension progressively and to pass the fabric several times through the machine, the required »softening« is thus produced without wearing the fabric.

Of the different machines we have just examined the stretchers, properly so called, are used for dry as well as damp goods; the openers or »scutchers« are specially employed for damp fabrics and machines such as the stretching machines by *Heilmann*, *Welter* and *Garnier* only act well on dry fabrics.

DAMPING AND DAMPING MACHINES.

The stiffened goods are still far from being done with, true, the fabric is starched and prepared, but it is still necessary to bring out the quality of the »finish« by calandering, or by embossing etc. and these operations are dependent upon a preliminary one. This preliminary operation, called »damping« is one to which little importance is attached, and upon which turns very often the successful or unsuccessful finish.

Let us see what happens if the goods be insufficiently damped. They become hard, rough, paper-like, take the pressure of the calander but imperfectly, fold badly, do not press nicely, and finally are unpresentable. If on the other hand the goods are too freely damped, then they become limp, flabby, without body, and have the appearance of having already undergone the soaping operation, in short we again obtain an unmarketable article.

To the fore going defects we must further add the serious fault of the goods becoming entirely spoilt, if they are left in a too warm or too damp place. In this case mildew is formed, and not only the colors but the very fabric itself may be destroyed.

From all this we can readily perceive how important it is that this damping process be most

carefully attended to, and not at all to be superficially treated, if we are to obtain regular and first-class goods.

We shall not deal here with the means employed for damping those goods intended for printing (wool, hand-printing etc.) as this would be too great a digression. We shall therefore only study damping as specially applied to finishing or stiffening.

The simplest method, borrowed in fact from the homely washerwoman consists in sprinkling the stiffened goods with a little brush dipped into water. It is evident that the goods are damped very irregularly, in consequence of the varying sizes of the drops of water and further through these being again irregularly distributed on the goods. Notwithstanding, this primitive method is still employed, we have seen it in operation in several pretty large establishments in Hungary.

Damping by hand, as just described, must of necessity lead to mechanical damping. Suppose for instance, instead of this little brush, we have a circular brush dipping into water; and driven with a certain velocity it will throw a spray of water to a distance. This is in fact the principle of construction of the brush damping machine. Fig. 63, page 198.

In this machine, which is nothing more than a batching roller furnished with a water reservoir, into which a brush dips, the goods pass through,

and the brush throws upon the cloth a spray of water which causes the damping. In front of the brush is a sieve to prevent too much water falling on the cloth and soiling the same.

This apparatus has been variously modified. Some makers place the brush underneath, and at a certain distance from the cloth. (Fig. 64, p. 199.)

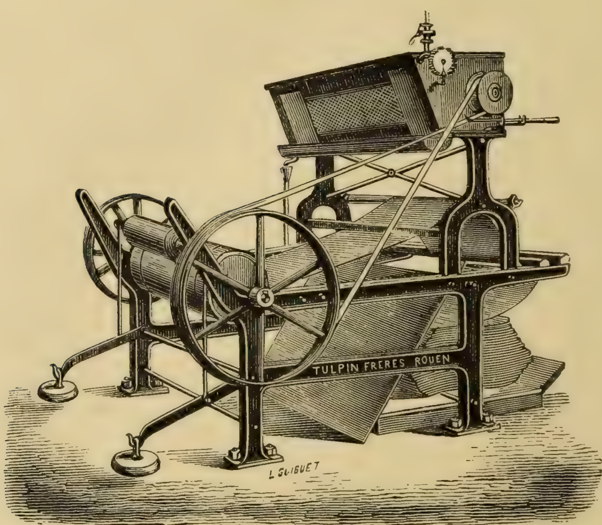


Fig. 63. Damping machine with brush above.

Under these conditions the damping is more regular, the large drops being carried away by their own weight, do not reach the cloth, which thus only receiving the small drops is more evenly damped.

Other makers again place one brush above and another beneath. To avoid the drops of

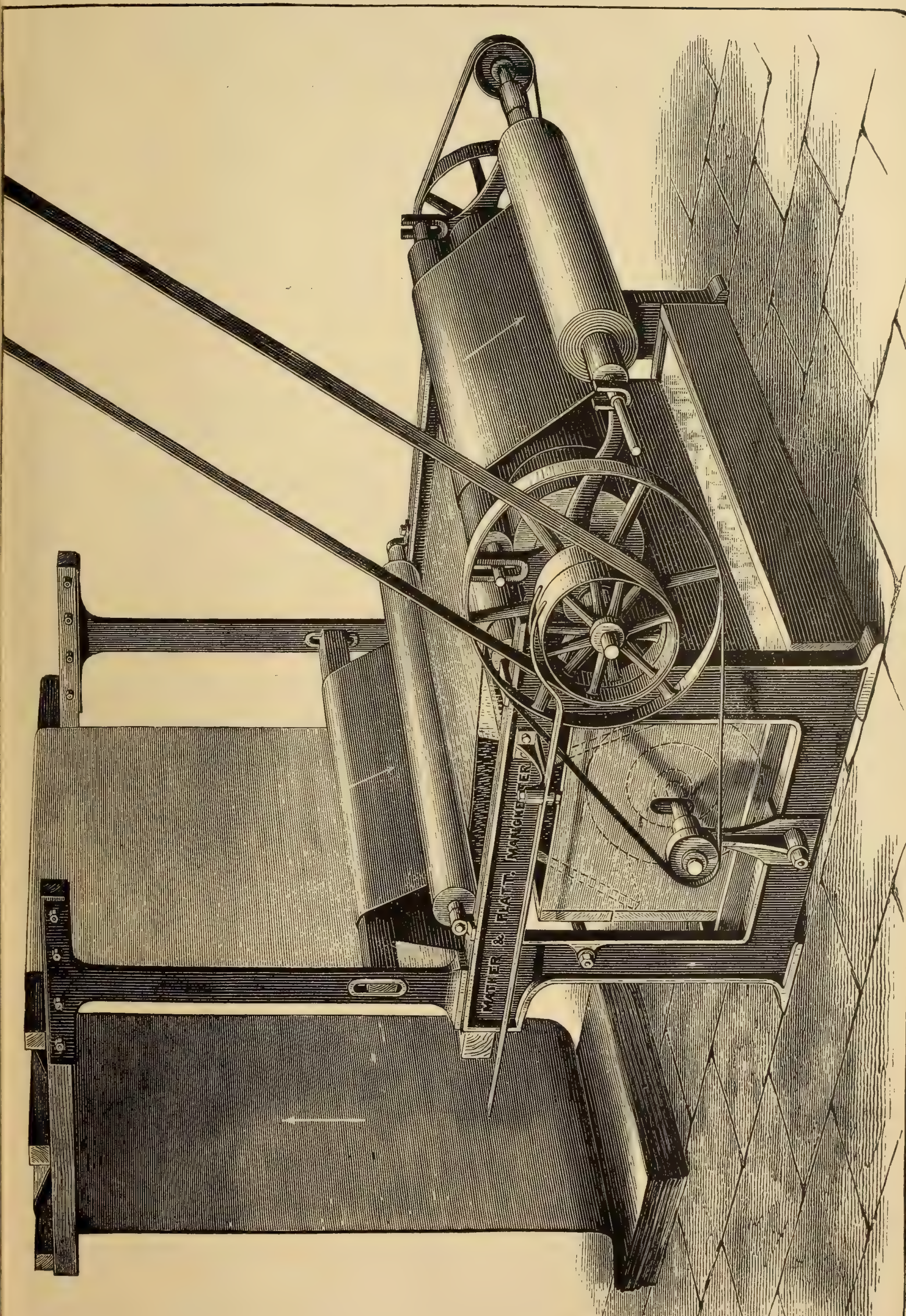


Fig. 64. Damping machine with brush below.

water a furnisher is placed in the reservoir and this limits the quantity of water the brush has to absorb.

Finally an apparatus has been designed with a varying level which gives exactly the same quantity of water to each special class of goods. It consists of a box hermetically closed and provided at the top with a pipe fitted with a cock, which conducts the watet into the box, at the side of this pipe is a small cock communicating with the air; at the bottom of the box is a let-off pipe fitted with tubes, these fitting into each other like a telescope. This same tube is also furnished with a cock. To put the box in motion, the bottom cock is closed, and water is allowed to enter through the top pipe taking care to open the air cock. When the reservoir is full (which may be observed by a water-guage fixed at the side) the top cocks are closed. Then the bottom cock is opened and the water runs off according to the diameter of the letting off pipe, into the box. When the level of the water reaches the lower orifice of the pipe, this is hermetically closed and a period of cessation occurs until the brush inside the frame has carried off all the water. The water then again descends from the box and re-ascends to the level of the orifice and so on; as the pipe is lowered or raised, the level of the water in the brush-trough is raised or lowered accordingly; in this way a very regular damping

is obtained, and we can also at will give different degrees of moisture by displacement of the bottom pipe by which the water runs off.

The following is also a frequently employed method; the goods after being starched, are left in a chamber for 12 to 15 hours where they absorb moisture. But this method does not give regular results inasmuch, as the goods are more or less dry according to the humidity of the atmosphere, and further, the selvages always become more moist than the interior.

A much more preferable method so far as regularity of damping is concerned is to suspend the goods in a cold hanging-room or loft. But here again we have a large expenditure of manual labour added to the chances of deterioration of the goods (»runnings«, smears etc.) which are very iable to occur from a double manipulation.

Some have had the idea of putting hygrometric salts in the starching mixtures. This method, which may appear practicable gives nothing but inconvenient results. If in fact the salt absorbs much moisture it is evident, that when the goods are deposited in the warehouse, they will have a tendency according to the quantity of salts contained, to absorb moisture in proportion to the dampness of the place. This process then must be rejected.

Another method employed in particular cases consists in rolling up the stiffened goods in slightly

damped coverings or »greys«. The goods absorb moisture by contact, but this process like the previous ones of this kind, always gives irregular results. It is besides only employed for white goods or goods printed in fast colors. Steam-colors would »run« and smear.

We have already mentioned, page 159, a method of damping to be applied immediately the goods leave the drying cylinders. A mixture of air and cold water is injected, the air cools whilst the water damps, but this damping can only be in any case provisional. It is indispensable to damp more thoroughly later on.

Francillon in Puteaux invented another system in 1862. He arranged a steam-jet to enter a box fitted at the top with a longitudinal narrow aperture the steam, very wet, escaped by this orifice above which the goods were passed. This method gave good results for woollen fabrics, but was uncertain for the damping of cotton fabrics; it is now replaced by the passage through Mather's oxydising machine which is extensively used for printed goods.

This apparatus, fig. 65, page 203, is composed simply of an iron chest furnished inside with metallic rollers over which the goods are passed; a strong jet of steam is let in which softens the goods, it is then easy to regulate the degree of moisture by opening the steam cock more or less. If it is desired to work with very moist steam,

the latter is passed through a reservoir of water where it becomes super-saturated with moisture. This apparatus is of great service where goods are to be only slightly damped. It must not be omitted to roll the goods up after leaving the machine, otherwise they would remain too dry.

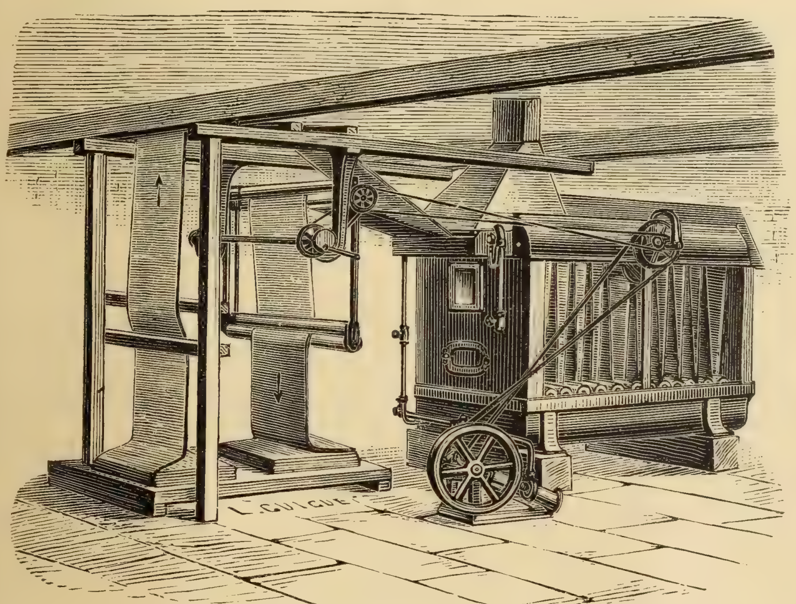


Fig. 65. Oxydising machine applied in damping. (1)

As the apparatus works very rapidly, the goods may be passed several times through the machine if required.

A method invented by *Herzog* of Reims, but little used for cotton fabrics, consists in using a

(1) This figure is taken from the »Diction. de l'industrie et des arts industriels« de *E. O. Lami.*

rolling-up apparatus surmounted by a perforated pipe, which communicates either with a reservoir of water, or with a pipe. The water runs out in little drops and falls upon the fabric, but this method is very irregular and we repeat is only used for woollen goods.

A similar method due to *Tulpin* of Rouen equally unsuitable for cotton goods consists of two rollers perforated with a multitude of holes; at the axis of these rollers a pipe is adjusted which allows the water to escape. These rollers when driven rapidly throw the water on to the goods.

In the brush damping machine *Fromm* of Mulhouse has suppressed the brush which he replaces with a wooden roller. Upon the perimeter of this are fixed according to the generators about ten sheets of zinc or galvanised sheet iron, at equal distances from each other and pierced with little holes, and bent in scoop form.

The roller revolves like the brush, but the hairs of this are now replaced by the metallic plates which, skimming the surface of the water take up a certain quantity and throw it upon the sieve, which then divides into fine spray in the ordinary manner.

Some idea of the working of this machine can be formed, if we compare it with a little hydraulic water wheel with buckets, worked in a contrary sense to its usual motion in calm water.

This machine requires little power and might render good service in many cases, but like all those we have just examined, it cannot damp in an absolutely regular manner.

The following machines are far superior to the foregoing, and their construction is based upon two totally different principles.

We may first observe that in many works, the goods are damped by means of the printing machine, that is, with an engraved roller turning in a reservoir filled with water, the roller furnished with its doctor. Above the roller engraved in pin style and not by slash-line (as rollers engraved this way allow the water to run off too quickly when the slash is crossed and furnish too much at one side when the slash is spiral) above the roller is a pressure bowl furnished with a blanket, the goods then pass between both rollers, under a certain pressure and are thus moistened equally and regularly.

A machine based on the same principle, but under other conditions is the following by *Mather & Platt* of Manchester, Fig. 66, page 206.

It consists of a large engraved copper roller with coarse pins. This roller dips into the water and is furnished with a strong doctor. Above the roller, and similarly as represented in the diagram of the back starching machine, fig. 15, page 106, two little copper rollers are adjusted. These may be raised or lowered at will and by

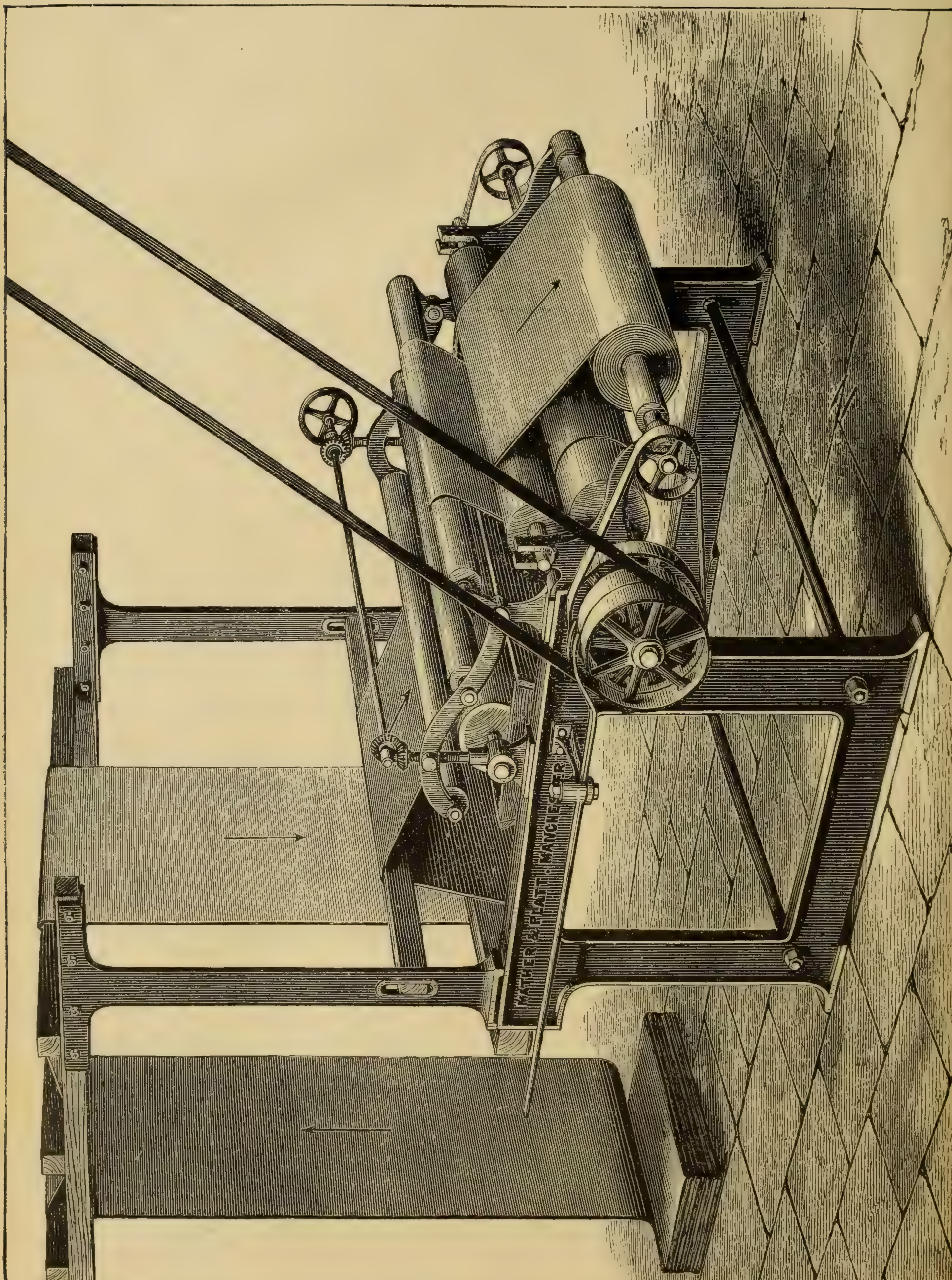


Fig. 66. Engraved roller damping machine.

their means the contact of the goods (which pass above) with the engraved roller may be increased or diminished.

The only important difference is, that the large roller turns in the direction the goods are moving and that the doctor consequently is placed in front instead of behind as shewn in this figure.

This machine damps very regularly and evenly, by means of screws which elevate or lower the contact rollers, we can determine exactly the degree of damping to be given for any style.

Another quite different type of damping machine, is based on the principle of the *Giffard* injector. It is known that if we immerse a pipe in water, and if at its orifice which passes beyond the level of the water to a distance of 20 or 30 centim. (8″ to 12″) we set a strong current of air passing at right angles there is a depression, and the water rising in the pipe, is projected at a given moment by the current of air, which, as it were, atomises it and spreads it a distance off in the form of a fine spray, fig. 67, page 208.

This idea was first applied in 1864 by *Stephan* of Berlin.

The machine which he constructed was composed of 20 to 30 pipes or tubes, with a space of about 6 centimetres ($2^1/_4$″) between each other; each of these tubes in direct communication with an air pump was fitted with a tap in order to

suppress, the action of any one of them if desired. To each of the air-injecting pipes was a correspon-ding pipe which plunged into the water. All the pipes when working were placed above a rolling-up apparatus, the goods passing below, were thus submitted to the action of an artificial shower.

One of the great advantages of this machine when well-constructed is that it gives no drops of water. All the sprinkling water is in such fine sprays, that the most delicate styles may be

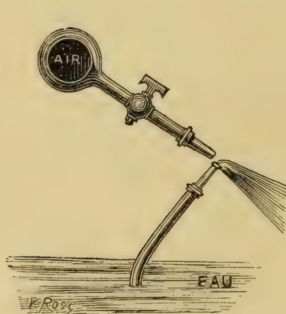


Fig. 67. Damping apparatus by injection.

damped without the slightest fear, which is neither possible nor prudent with the other dampers.

Welter & Weidknecht have modified the appa-ratus by adding a ventilator independent of the action of the rolling-up apparatus, so that before the goods are manipulated in the machine, they can be already damped completely even at the ends.

Tomlinson modified the apparatus by placing the goods at an angle of 45° to prevent the least possible loss of water forming the spray.

Other improvements, less important, and only relating to the construction were invented by Weisbach, Gaulton & Booth and Flinsch.

A notable improvement is due to Gebauer. He placed a first system of damping above the goods and a second, below.

The play of each can be so modified or arranged that in proportion to the angle given to the spray tubes more or less water can be thrown upon the goods.

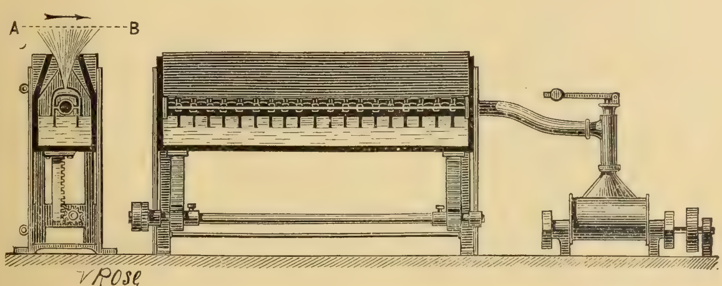


Fig. 68. Bentley & Jackson's Double acting damping machine.

The apparatus is further so arranged that the top or bottom system, or both simultaneously may be worked and finally the latest improvement in this class of damping machines is by Bentley & Jackson (fig. 68, p. 209). (1)

The section of the figure shews a central pipe in connection with a strong ventilator; on each

(1) Fig. 67 and 68 are taken from the Dictionary de l'industrie and have been kindly placed at our disposal by Mr. *E. O. Lamy.*

side of this pipe, are the little pipes conducting the water. These are so arranged that the spray of water is thrown into the air, the larger drops, in the rare cases where such are produced, cannot reach the goods and to facilitate regular sprinkling the top of the apparatus is furnished with two

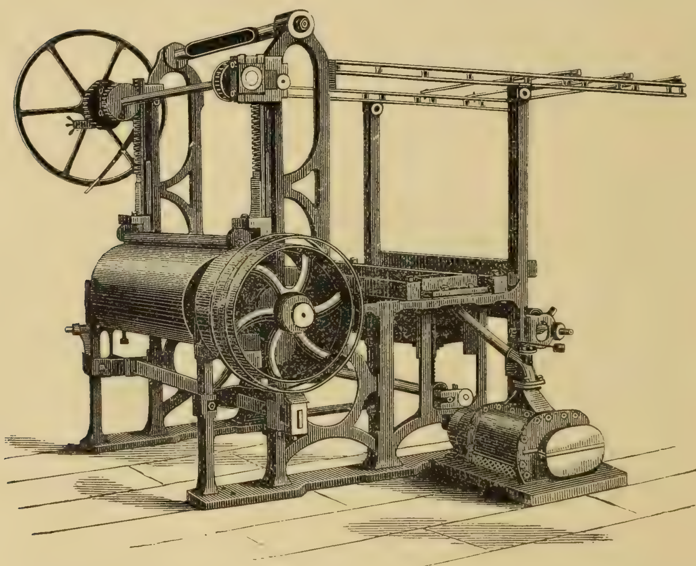


Fig. 69. Bentley & Jackson's Damping machine with double injector.

small boards shewn above, A & B, and which decrease or enlarge the area of action of the Damping Machine. Besides this the water box is provided with a rack which allows the level of the water to be altered at will; we have then here every possible facility for giving the most minute regularity to each operation desired.

Fig. 69, p. 210, shews this Machine complete, with batching apparatus ventilator and special arrangement for pressing the goods after damping, so as to moisten better.

Other modifications of no great importance have been made by Knapp, Schwabe & Popp etc. (Vide Grothe, Die Appretur der Gewebe, p. 425.)

BATCHING APPARATUSES.

In most of the apparatuses we have described up to the present the fabric enters in a folded state, being rolled up as it leaves the machine. We must therefore devote a few lines to those machines specially used for rolling-up or batching. These are usually very simple and are composed in principle of a frame carrying a drum worked by the pulley driven from the shafting. Above this drum a roller with an iron axis is placed, and upon which the goods are rolled up. From the entry of the goods to the drum, crimp rails of wood or iron, brushes etc., are fixed.

In printing the batching apparatus or Canroy, plays a more important part than in finishing and it is indispensable in the first case to have efficient machines. For this reason in printing works the canroys are fitted with rods for beating the cloth and with brushes for cleaning them, with expanders for taking creases out, with cold or hot cylinders

for smoothing or drying the goods as desired. In finishing it is sufficient to roll the goods up conveniently without folds or creases and thus only the simplest batching apparatuses are employed, as already stated these are invariably attached to the machine and have been partly described. We can dispense therefore with further details relating to this subject.

FINISHING AND GLAZING CALANDERS; GLOSSING AND LUSTREING APPARATUSES.

One of the apparatuses which has been subjected to the greatest modifications is certainly the Calender.

Its use dates several centuries back and if we cannot determine when it was invented we know at least that Léonard de Vinci has left in his notes, a sketch without text, representing a calender.

According to Knight, the English only knew the calender through the French refugees who imported it: it is also admitted that the French became acquainted with it through the Italians. What is certain is that in 1790 (according to the Transactions of the Society for Encourag. XV. page 269 and Die Appretur der Gewebe — Grothe. 437. a Mr. Bunting had already constructed a Calender composed of three cylinders or bowls, two being of wood and the intermediate bowl of

metal and hollow, to as to heat by bars. We find in the »Annales des Arts et Manufactures XIII.« page 79. the description of paper bowls intended for Calenders. Still further back, we find, that the celebrated Vaucanson also busied himself with these apparatuses, seeing that he invented a watering calander. (See Histoire de l' Académie Royale des Sciences. Paris 1772, page 5).

The simple calender as we know it, that is consisting of two bowls running one above the other and pressing upon the fabric is indeed of European and modern invention; but the necessity for glazing or lustreing goods we find exists equally with peoples who have no sort of industry. Thus in Senegal, the natives have used since immemorial times a little bench, which they call »taparka» or »dom«. They place it on their knees like a little table then spread upon it their »guinees« or blue stuffs and rub these with shells (see note p. 6) the fabric being previously coated or stiffened with ricewater, wax and slightly perfumed. (Fig 70, p. 214, taparka.)

This very primitive kind ot glazing machine constitutes a piece of family furniture and is generally adorned with white, red and black designs. (1)

The Chinese also glaze their cloths and their manner of procedure, excessively simple, has a great

(1) See Catalogue of French colonies at the Exhibition of 1878. Senegal p. 139.

resemblance to the German »mangle«. There is a small model of one of these glazing machines at the Conservatoire des Arts et Métiers in Paris. It was shown in the Chinese section in the Paris universal exhibition held in 1878.

The fabric rolled by hand upon a wooden roller is placed on a hard and level platform, two rollers are placed beside each other a few inches apart, then a large block of wood which resembles somewhat a small ship is placed above, that is,

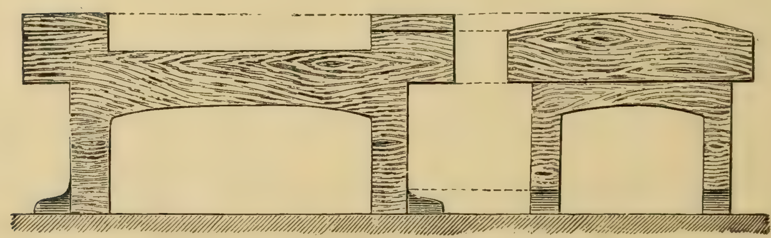


Fig. 70. Taparka.

the top is horizontal and the bottom forms an arc of a circle, a workman places himself on this block and holding by his hands to a bar fixed in the wall he makes the block slip with his feet by pressing upon one or the other extremity, in this way a sort of to and fro movement is made, which acts upon the rollers and carries them along by friction. This movement repeated a number of times gives a certain lustre to the fabric.

The simplest calender consists of two rollers or cylinders, one of which is metal and the

other paper. (We shall return later on to the method of making paper bowls and keeping same in repair.) By means of screws, levers etc. a pressure is given to these bowls between which the fabric passes and the fibres thus become flattened. The ordinary finishing calander called »cylinder« on the continent does not glaze; calanders may have from two to seven bowls and worked either hot or cold.

Hot calendering is done in various ways: the most primitive method is heating by bars. The metal bowl which in this case is hollow, is heated by a red-hot bar of iron. This method is still employed when great heat is required about 350^0 C. (or 662^0 F.) can be obtained, but this method is very injurious to the paper bowls. These heated bars or bolts are from 6″ to 12″ long according to width of calender and the diameter is a shade less than the orifice of the metal bowl to as to fit inside same (usually $^{13}|_{16}$″ to $1^3|_{16}$″). These hot bolts are put in and taken out with suitable tongs. The disadvantages of this system are: the difficulty, almost impossibility to produce a well regulated heat, the laborious and tedious manipulation of the heated bars and the already mentioned pernicious effect of the high temperature on the paper bowls. Another very convenient method of heating is by gas. Its application is simple, it is relatively economical in consequence of its continuous work and of its regularity: a $^3|_4$″ gaspipe is all that is required.

The combustion is accelerated by a mixture of air under strong pressure produced by a fan. The gas must burn blue and with intensity. If lamp-black is deposited inside the bowl this indicates absence of air and consequently incomplete combustion. The gas must be lighted very cautiously as an explosion is easily caused; a wax taper fastened to a holder is generally used or in preference the little electric induction apparatus (Clarks) particularly recommended for mills where cotton is worked. Heating by hot bars and by gas gives the highest temperature and consequently the most beautiful glaze is obtained. Heating by steam gives less satisfactory results; a pipe with two flanges is inserted in the hollow bowl to be heated, the steam is admitted at one end and at the other a copper pipe is fastened which projects into the cylinder and serves for the escape of condensed water to be taken off by a steam trap placed at the outlet.

When the cylinders are at rest, care should be taken to isolate the bowls otherwise the pressure upon the paper bowls forms a furrow which is reproduced in stripes across the fabric.

The use of steam for heating causes so little detriment to the paper bowls that they last 10 to 15 years without being re-turned and then only require a few millimetres turning off, whereas the red-hot bar heating system has such a deteriorating effect on the paper bowls owing to intensity of heat developed that they become quite soft and

require to be turned after three or four years working and not only a few millimetres (sixteenths) but centimetres (1 cm. = $^{3}|_{8}{}''$), the effect on the bowls is sometimes so pernicious that the paper falls off in large scaly pieces.

From the preceding remarks it is obvious that to obtain a good calendering it is better to use a strong pressure with a lower temperature than a weak pressure with a high temperature. Speed has also a certain influence and for this reason it is better that calenders of all kinds should have a separate motor; the speed can be easily regulated and combined with the heat and pressure required for the calendering wanted.

Calenders having to finish or glaze the fabric without injuring the fibres it is necessary to use a hard or metal bowl against a less hard or elastic bowl. Wood bowls under ordinary conditions would not stand the desired pressure, would warp and would not glaze well. Several kinds of bowls have therefore been invented, of paper, of old ropes of linen, of parchment, of cellulose, of asbestos, of india rubber of glass even (*J. Chedgey's* patent 1852). Other makers tried stone ware, porcelain, earthenware (*Parkinson*) metal centre covered with cement, artificial stone marble (*J. Harrison*). All these methods are superseded by the steel bowl and paper bowl which are almost exclusively used to-day. (1) The

(1) Cotton bowls are also extensively used. Ed.

manufacture of this latter deserves notice: the bowl is formed of an axle strong enough to resist the great pressure without bending and the strain produced on it by the compression of the paper. At each end this shaft is screwed to receive the nuts supporting the plates, they may be fixed by means of circular keys, the plates themselves are bored with 4 or 5 holes into which are inserted the tie-irons which hold the paper and prevent it from springing.

The paper must be of specially pure quality and free from mineral substances. The best are made from linen or hemp and can cost as much as one shilling per pound which explains the high price of these bowls; the paper is cut in circular pieces with hole in centres to suit the diameter of the shaft; these are placed upon each other in layers of 2 to 3 inches deep and are subjected to a great pressure, which for large diameters reaches 400 tons. After being in the press under this pressure for 24 hours a further charge is added each day until the bowl is completed; the paper is held in position by the plates and screws and turned off to desired diameter.

For a bowl 1 metre ($39^3/_8''$) in length twenty thousand sheets of paper weighing 4 to 5 cwt are required. The manufacture of these bowls being most delicate and onerous they are expensive and should receive special care and be kept in good order; soap, acetic acid, curded milk etc. are used,

but all these expedients should be rejected: the simplest surest and most practical is the following. The bowl is damped with a sponge saturated with clean water, then a wet cloth is wrapped round it for an hour, or an hour and a half then the calander is set in motion gradually, at first with a light pressure and little heat, then progressively increased until the bowl becomes perfectly even. When the bowls are soiled by the starch detached from the fabrics, or by coloring materials discharged by the action of the heat and pressure, they may be washed with a weak solution of good soap (1 gramm about to a litre of water (one oz pr. gal.) and dried afterwards whilst running under a light pressure.

On different effects obtained with Calanders.

When goods are passed between a metal and a paper bowl at light pressure a dull and lustreless finish is obtained.

The more the pressure is increased the greater the glaze, and with heated metal bowl still more brilliancy is obtained, the heat of the bowl drying the tissue gives it besides a »feel« and smarter appearance.

It is always advisable to slightly damp the goods before calendering; for glazing they require more damping than for simple finishing. With the ordinary calender only a simple finish can be obtained. For glazing the machine must be specially arranged

friction being produced by the metal bowl slipping or rubbing upon the fabric adhering to the paper bowl. To produce this effect the metal bowl must revolve about one and a half times quicker than the paper bowl.

These two bowls are connected by gearing, the diameters of the wheels being in proportion to the friction desired. More friction is required for a thick fabric than a thin one and it must be noted that soaped goods glaze more readily than non-soaped ones; the latter have a greater tendency to give off a »fluffy« or »woolly« appearance.

The quality of the finishing material has also a considerable influence upon the glaze produced.

When dull finishes without the least lustre are desired the calender is modified as follows: one or both bowls are lapped 10 or 12 times round with a cretonne. If one cylinder alone is covered only the side touching the lapping will be dull and the side in contact with the metal or paper bowl will have a certain lustre: if both bowls are provided with lapping the calendered fabric will be quite dull on both sides.

When a soft »feel« is required another method is employed: the middle cylinder is covered with an endless woollen blanket, which can be stretched as required by means of a screw placed upon the journals of the cloth tension roller.

Fig. 71, p. 221, shews the simple passage and Fig. 72, p. 222, shews the double passage, that is to say that in both cases there is only one side not glazed unless the top or bottom paper bowl be itself covered with lapping.

This simple passage is much used in printworks etc. giving a greater production with the ordinary 3 bowl calender, the question of ordinary finishing or dull glazing being indifferent as both can easily be produced: the principle point being that with the

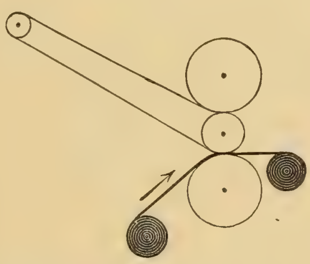


Fig. 71. Calendering with endless blanket simple passage.

same machine, the same labour, the same power two pieces can be passed and finished instead of one. This arrangement was already in vogue in 1828 at *Witz Blech's* works in Cernay and received a favorable notice from *La Société Industrielle de Mulhouse* (1829 see also *Persoz*, Traité de l'impression des tissus. Vol. 4, page 514).

Under ordinary conditions, if it is desired to give a light pressure with the 3 bowl calender,

a simple passage between 2 bowls is employed and the pressure between the 2nd and 3rd bowl is not used. See fig. 73, p. 223.

If the movement of the machine be reversed by crossing the strap, two pieces instead of one can be simultaneously passed by simple alteration of the letting in scrimping bars and batching apparatus, this will be readily understood by a reference to fig. 74, p. 224.

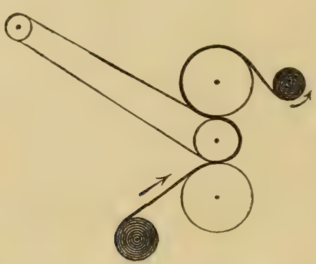


Fig. 72. Calandering with endless blanket, double passage.

On page 225 a series of diagrams are given shewing the various methods of passing goods through calenders. They can be considerably modified: of course by heating the metal bowls; more or less damping; by varying pressure or lever weights, by the speed, by the composition of the finishing mixture and finally by the various operations the goods undergo before or after the calendering; as »Breaking«, Beetling, Mangling etc. This simple enumeration suffices to shew how numerous are

the various finishes that can be obtained. Take a 6 bowl calender for instance, the first cylinder of which, starting at the bottom, and the fifth are of metal and which can be heated, the second third, fourth and sixth of paper and of larger diameter than the metal ones.

We will suppose, for it is not the case in a 6 bowl calender where the pressure is generally given from the top, that the top or bottom bowl

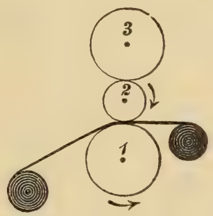


Fig. 73. Ordinary passage with 1 piece.

can be worked as desired. We again repeat that in passing goods between a metal bowl and a paper bowl the minimum of effect is produced when cold, when heated more glaze is obtained in proportion to the heating and for this reason some finishers still prefer the heating by Bar system to which we shall refer later on.

Fig. 75, p. 225 represents the cloth passing once between the third and the fourth bowl; this gives the least effect and is without gloss as used for dull styles, cretonnes etc.

Fig. 76, p. 225. The passage between bowls No. 1 and paper bowl No. 2 gives a little better result than the preceding, the side coming in contact with the metal bowl is more glazed and this in proportion as the bowl is heated. The piece has one »nip« only.

Fig. 77, p. 225. In passing between three paper bowls (two nips) the goods are flattened twice but not glazed.

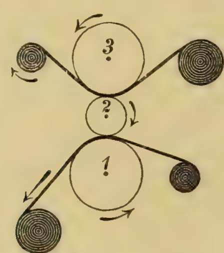


Fig. 74. Passage with 2 pieces on the same machine.

Fig. 78, p. 225. Passage between 3 bowls, middle one of metal, strong pressure. The piece is well pressed twice and one side is moderately glazed.

Fig. 79, p. 225. Passage between a metal bowl and 2 paper bowls. This gives a more flattened appearance, but less glaze than the foregoing, the goods receive 3 »pressings« or nips.

Fig. 80, p. 225. Passage between the 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} bowls, the fabric is thus pressed four times and a strong glaze obtained.

PLATE VI.

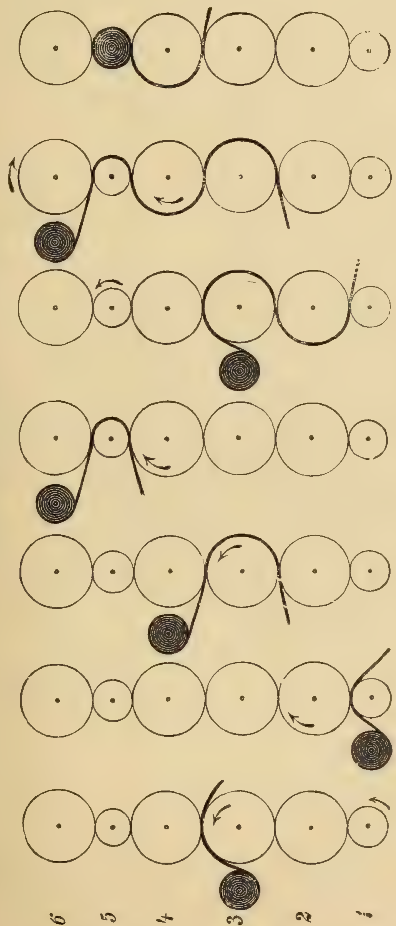


Fig. 75. Fig. 76. Fig. 77. Fig. 78. Fig. 79. Fig. 80. Fig. 81.

Diagrams of the different methods of calendering.

This method is difficult to manage for if the least fold occurs, the piece is cut and irretrievably spoiled.

Fig. 81, p. 225. Passage between 3rd and 4th bowls then batched in the 5th. By this method not only a glaze is obtained but also a watery effect imitating the mangle finish and which is called »moiré«, but it is not the real »moiré« as we shall see further on.

Certain kinds of calenders called water-mangles are used for squeezing-out the water from the goods after bleaching or dyeing. They are somewhat differently constructed from the others and require to be well made with strong framing on account of the heavy pressure they have to bear. The middle bowl is usually of brass and the others of very hard wood, generally sycamore, they have 3 or 5 bowls. (1)

Fig. 82, p. 227, represents one of the best calenders of this kind, it consists of 5 bowls, the 1st, 3rd and 5th are of bronze and the 2 intermediate ones of wood, the middle metal bowl is arranged for heating and for friction. Pressure is given from the bottom by means of levers.

This machine can also be used for starching and thus fulfils the conditions of the mangle described p. 96, fig. 8. It is provided with double cylinder diagonal steam engine which allows the speed to be varied according to the goods operated upon.

(1) The best water-mangles have at least 6 bowls, 3 brass and 3 cotton.

Beautiful finishes can be obtained with this machine as the wet goods being well squeezed are better mangled and in the proper condition

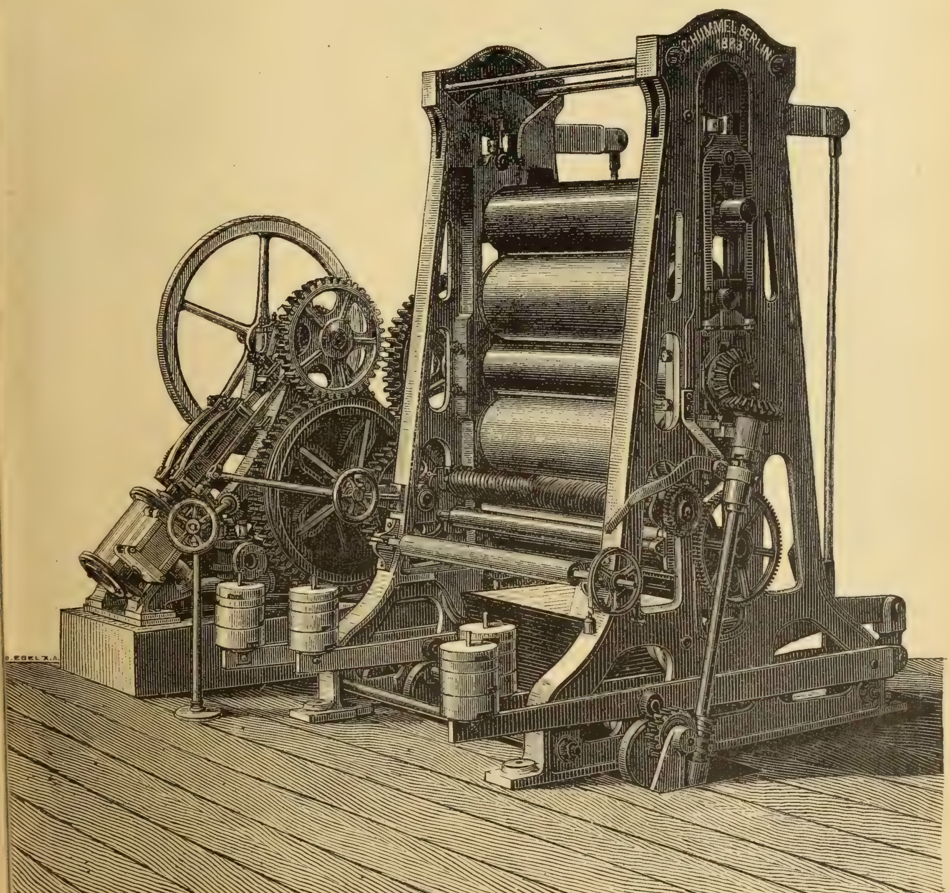


Fig. 82. 5 bowl water mangle with steam engine and friction apparatus.

for producing the back finishes; the flattened threads lie closer and the finishing materials pene-

trate much less than when the goods are starched in a dry state.

Up to now we have only examined the simple passage between two bowls but other effects can be produced by passing the same piece continuously several times through the same bowls.

Fig. 83, p. 228. This produces a sort of moiré which is a fair imitation of the effect obtained with the mangle. The finish is supple with a good body. This method is often employed for heavily starched white good.

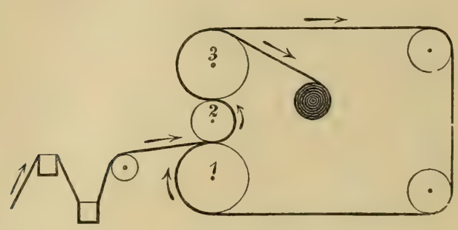


Fig. 83. Multiple calendering.

It is essential to carefully watch the entry of the goods for if creases are produced the goods are cut and quite spoiled. To facilitate the working a blanket is used which serves as a guide and remains in the machine; it is not necessary therefore to re-arrange the machine which takes a deal of time. In this particular case great pressure is generally used. A moiré is thus obtained which is like that of linen passed through the large chest mangle.

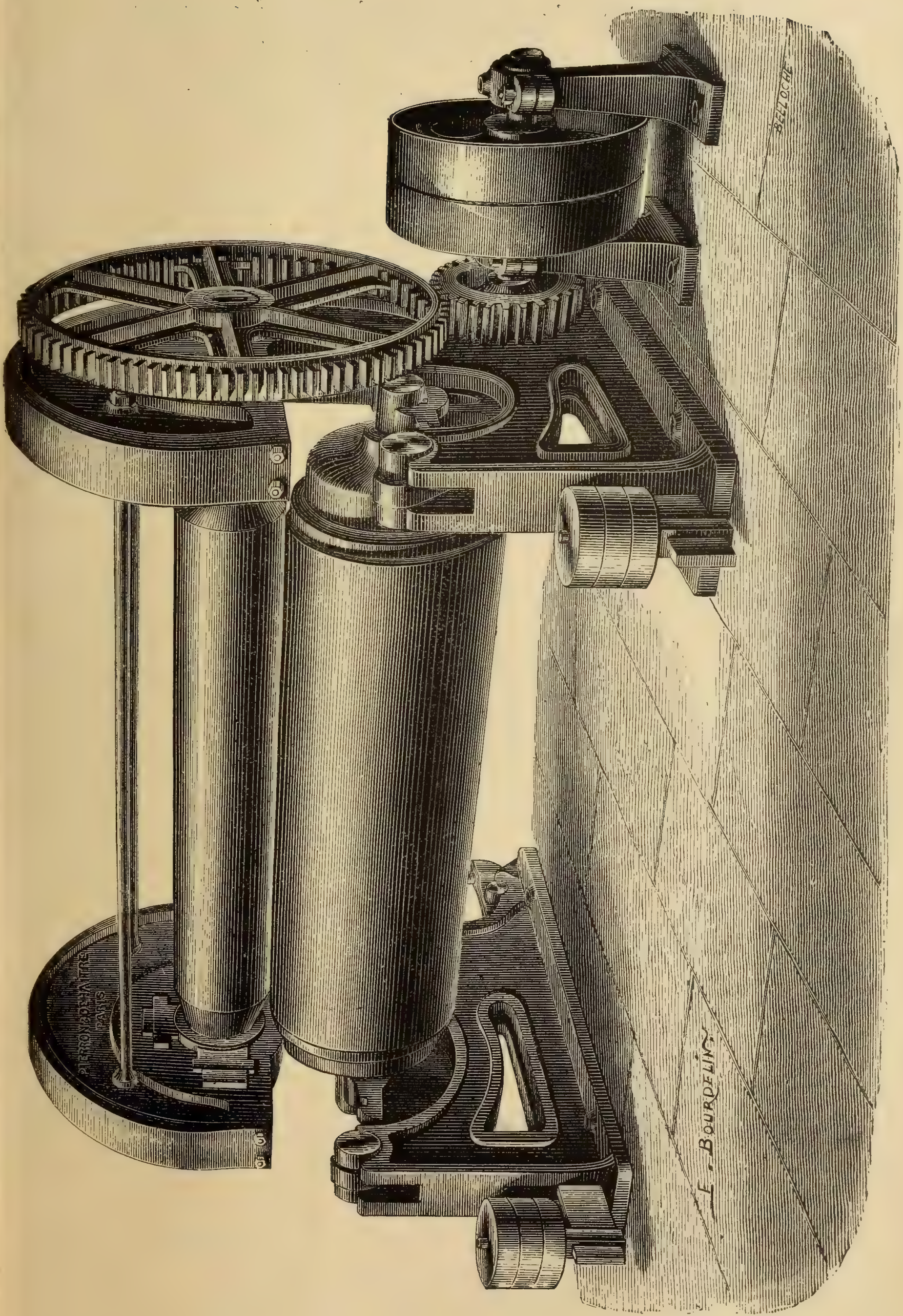


Fig. 84. 2 bowl calender with strap driving and pressure by levers from below.

Description of the different kinds of calenders. The simplest calender is that shewn in fig. 84, p. 229. It consists of a paper bowl below and a steel bowl above, the motion is given by the steel bowl to the paper bowl.

The pressure is given by levers from below. Under normal ordinary conditions, the pressure exerted is about 35 to 40 kilos per lineal centimetre (200 pounds per lineal inch). The proper speed is form 10 to 15 metres per minute.

Fig. 85, p. 231, represents a 3 bowl calender with the metal bowl in the middle. Pressure is given from above at first by levers, then by screws independent of each other. This apparatus is driven by straps.

Fig. 86, p. 232, represents Farmer's moiré lustre calender. This calender is an ordinary 3 bowl calender with top and bottom cotton bowls and one middle steel bowl heated by steam and arranged to run with friction on the bottom bowl. A special vibrating or wave roller (not shewn in illustration) is adopted when the moiré lustre finish is to be produced, and for the same purpose the middle plain steel bowl is replaced by a steel roller engraved with fine circular grooves, which run with friction on the cloth. The waving motion is given by hand or actuated by a mechanism, so that the pattern may be altered at will.

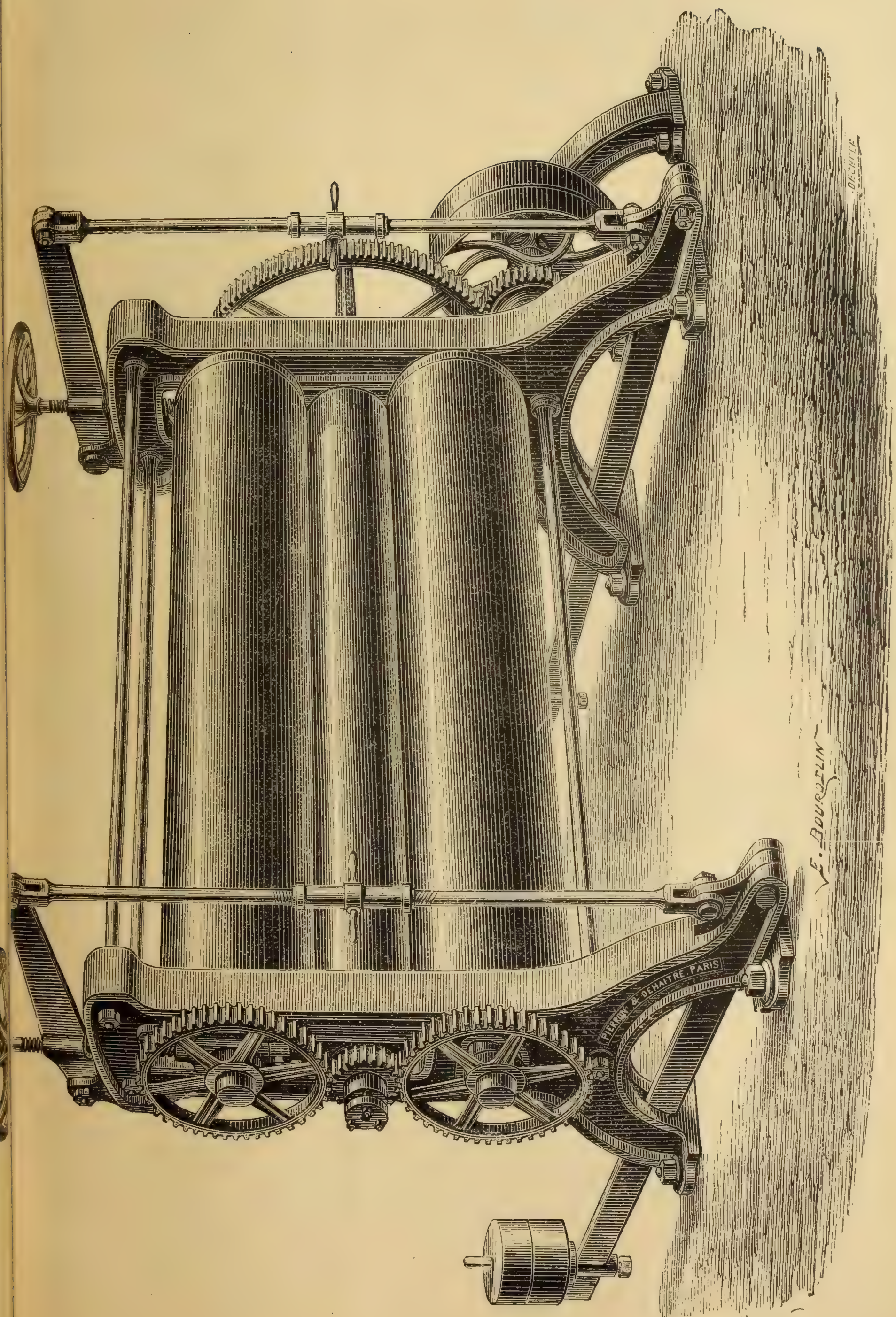


Fig. 85. 3 bowl calender with strap-driving top levers and independent pressure screws.

Fig. 87, p. 232 B, represents a similar type driven direct by a steam engine. In this system the metal bowl is in the centre.

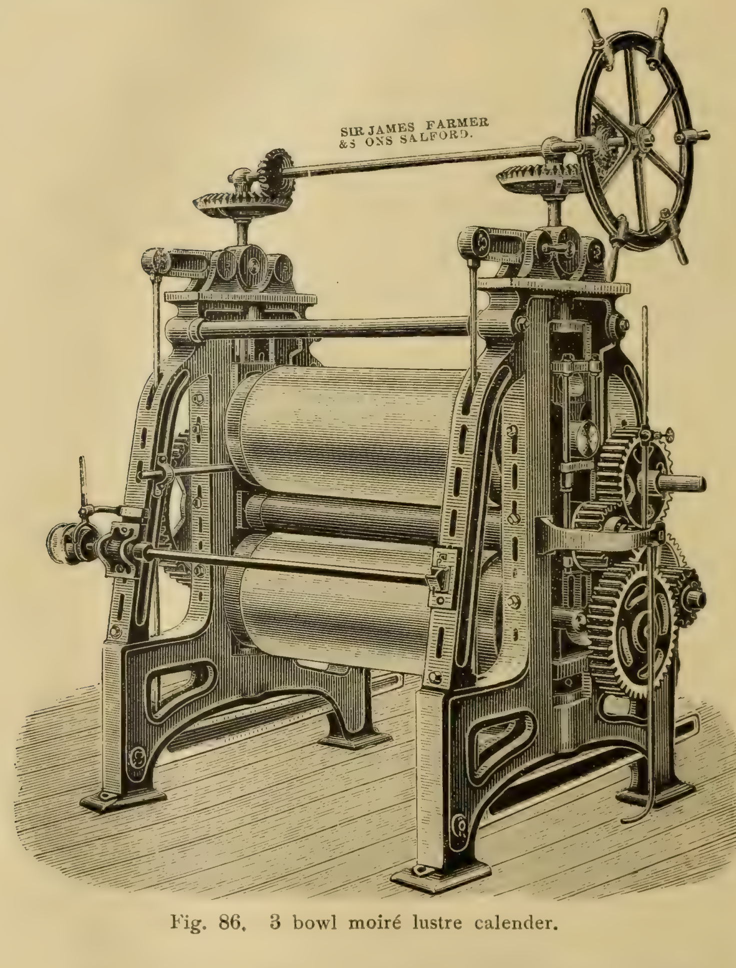
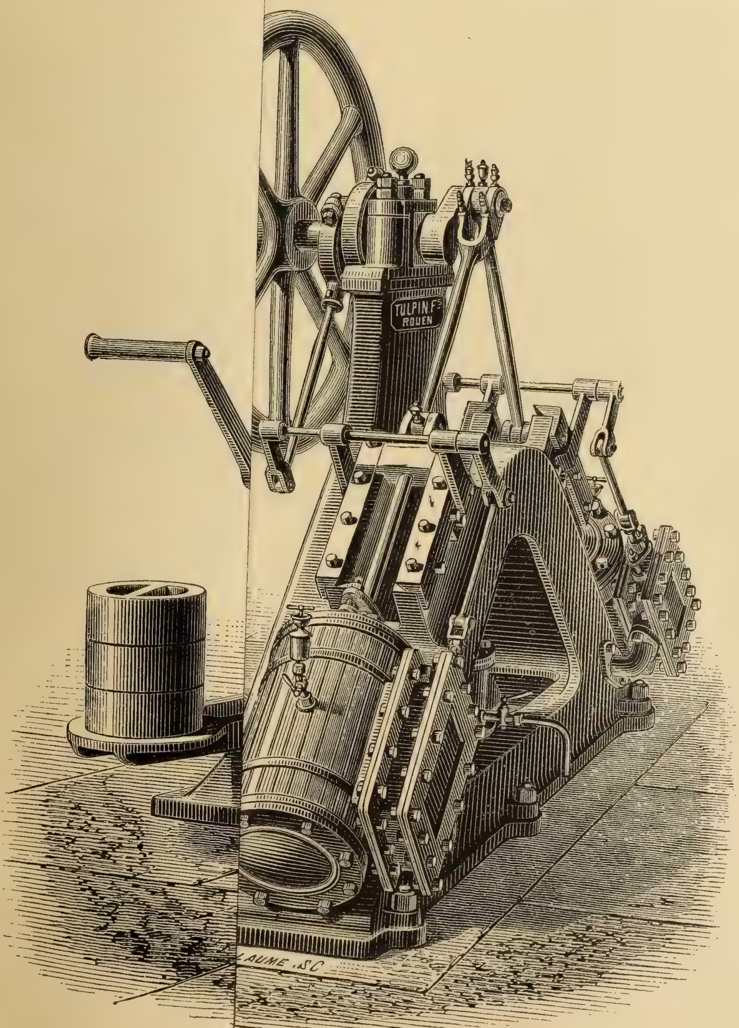


Fig. 86. 3 bowl moiré lustre calender.

Fig. 88, p. 233, represents Farmer's 3 bowl beetle finishing calender.

This calender is devised to work in connection with the beetle. The top bowl is made of paper,



VS.

FOLDOUT NOT DIGITIZED

the middle of cotton, and the bottom one of cast iron so that a soft nip between the top and middle bowls is obtained. The machine is constructed to work under heavy pressure, the diameters of the

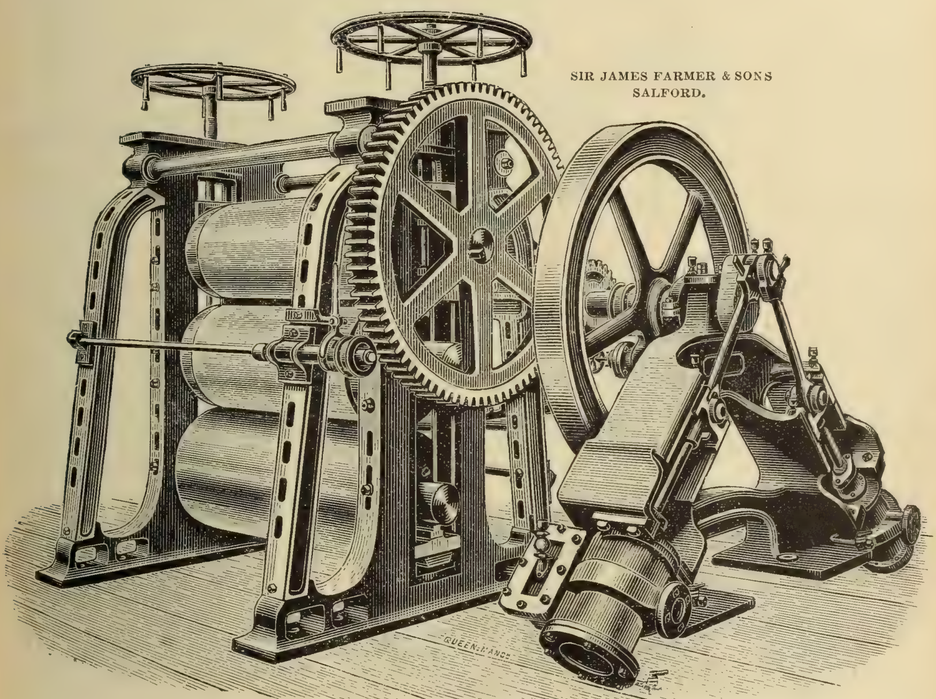


Fig. 88. Farmer's 3 bowl beetle finishing calender.

bowls are large to prevent any springing, and the frame very strong to avoid vibration. It is shewn as driven by a powerful double cylinder diagonal engine which permits of it being run at various speeds.

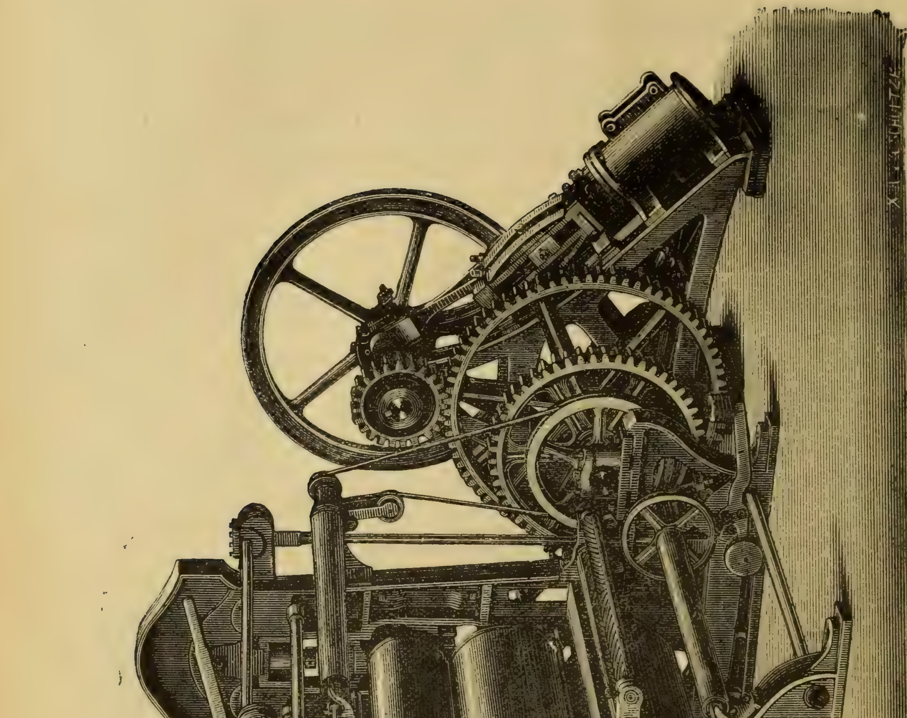


Fig. 89. 3 bowl calender with steam engine metal bowl above and heating by bars.

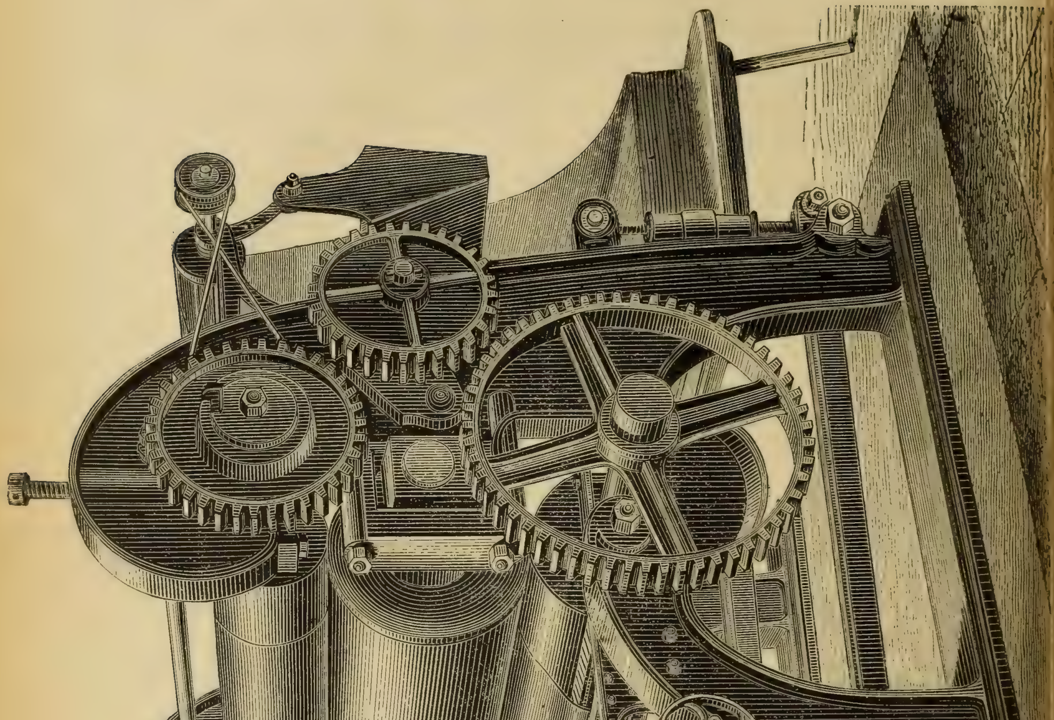
So far we have only treated of those systems of calenders without heated bowls.

Fig. 89, p. 234, represents a calender which can be worked with or without friction, with its own steam engine and with lever pressure from above; the top bowl is hollow, and arranged for heating by bars; by a special arrangement it can be isolated from the middle bowl, in order to be able to use the two bottom bowls alone.

Fig. 90, p. 236, represents a 3 bowl calender driven by strap with top metal bowl, and arranged for heating by steam. Above are regulating pressure screws, at bottom levers are fixed. Behind the calender either a plaiter down or batching-roller is applied. The top bowl is furnished with a cog-wheel which may be dispensed with if desired for ordinary finishes when worked in conjunction with the intermediate wheel friction is obtained.

When the goods are to be specially glazed, the 4 bowl universal calender shewn in fig. 91, p. 237, is employed.

This machine has an iron bottom bowl, two cotton or paper bowls and one chilled iron friction bowl. The latter is arranged to be heated by steam or gas, and the intermediate friction wheel can be easily taken out of gear, so that the machine may be used either as a friction or as a swizzing calender. A Stanley or lubricating roller is provided to keep the friction bowl clean, and a set of chasing rollers are applied so that the calender



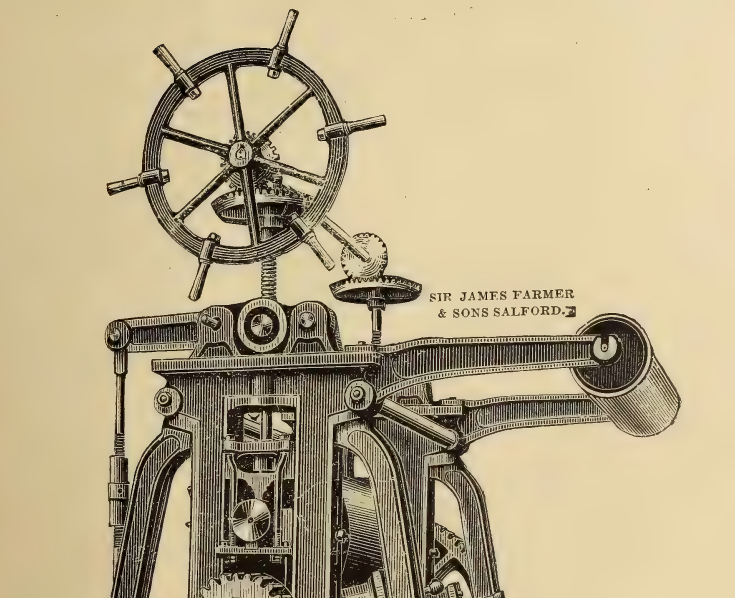


Fig. 91. Farmer's 4 bowl universal calender.

can be used for producing a great variety of finishes, which is very convenient when limited quantities of goods have to receive various finishes. This

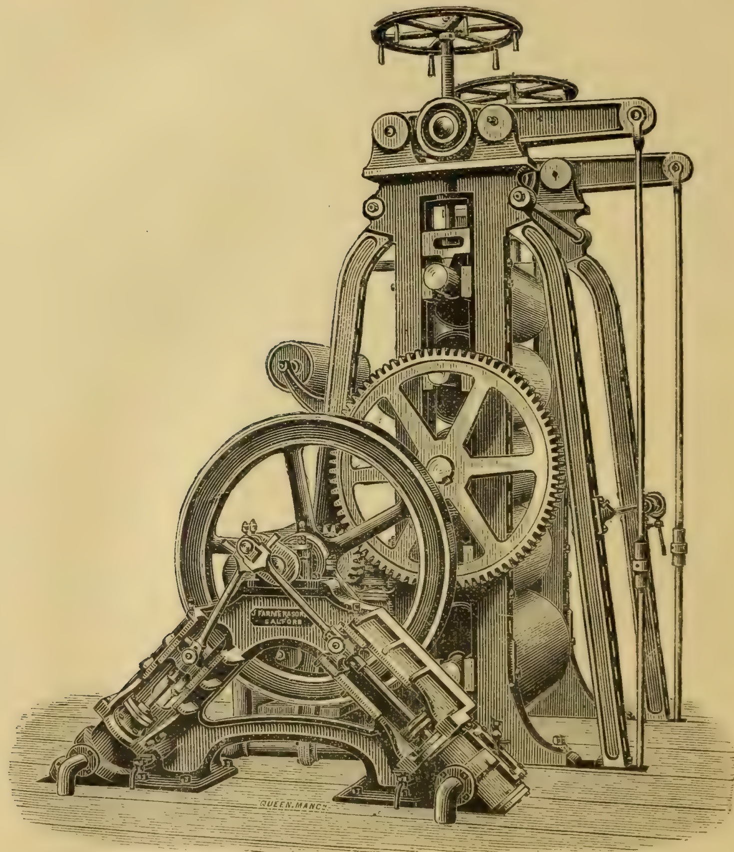


Fig. 92. Farmer's 5 bowl imitation beetle finishing calender.

machine is shewn as driven by fast and loose pulleys, it is however more advisable to provide it with a direct engine, the latter allowing the

speeds to be varied according to the finishes, besides dispensing with belting and gearing.

Fig. 92, p. 238, represents a more perfect finishing calender. This calender is most suitable for working in connection with the beetles, where the high-class beetle finish is required; the goods being subjected alternately to the beetling and calendering operations. The imitation beetle finish can be produced on it without subjecting the goods to the beetling action, and for this purpose a set of chasing rollers is adapted.

According to purposes the bowls are arranged as follows:

top paper	or cotton	or paper	or iron (heated)
» cotton	cotton	cotton	cotton
middle paper	paper	iron (heated)	iron (heated)
» cotton	cotton	cotton	cotton
bottom iron	cotton	iron	iron

the two former arrangements being the most convenient for the pure beetle finish, the two latter for the imitation beetle finish.

The framing is extra strong and provided with heavy compound levers, and a powerful engine generally adapted to drive this calender, the latter having to be run at various speeds according to the amount of moisture in the cloth.

Finally the 7 bowl universal finishing calender fig. 93, p. 240. The arrangement of the bowls in this calender is as follows: — 3 cotton bowls placed between

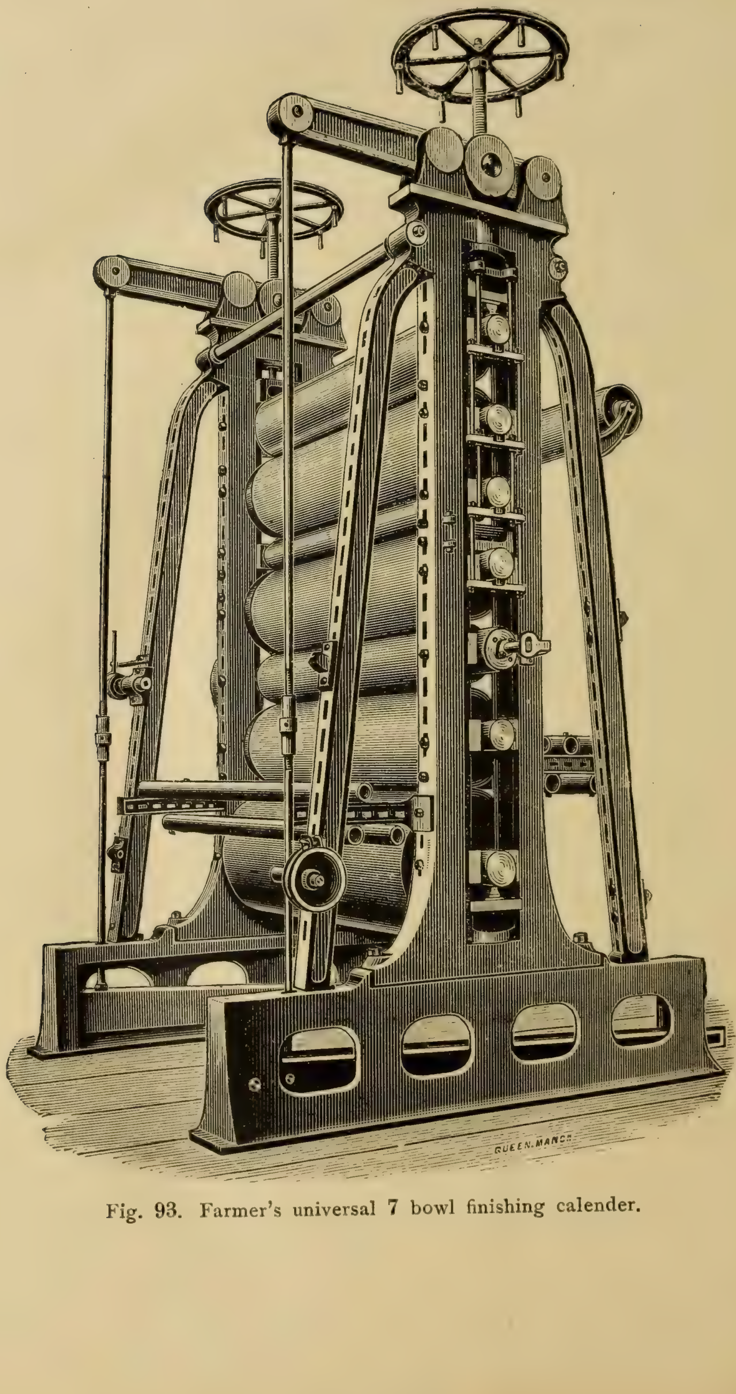


Fig. 93. Farmer's universal 7 bowl finishing calender.

top and bottom cast-iron bowls, one middle iron bowl heated by steam and one solid steel bowl. These large 6 and 7 bowl calenders prove themselves very useful for general purposes, they are sometimes provided with friction-wheels and double set of compound levers to use the three bottom bowls alone as a friction calender.

Double batching and letting-off arrangements are applied, so that two pieces may be calendered simultaneously. A set of chasing rollers is also generally applied, and the calender is most suitably driven by a direct engine.

With the various calenders just described from dull to satin finishes are obtained, but for a *perfect* glaze other methods must be used.

Formerly lustreing or glazing was done either by hand, or by very primitive apparatus, which consisted of a wooden framing with a wood spring or lever fixed to the ceiling, the other end being connected by a pin to a crank lever carrying at the end a small roller of highly polished agate. The piece of calico prepared either with wax or in some other way was placed on a sort of table furnished with a longitudinal groove, along which the agate moved to and fro glazing the piece as it was slowly fed through the apparatus.

With such imperfect means it can be understood, only a small quantity of goods could be glazed per day, and further the process required a great number of work-people. With the deve-

lopment of manufacturing and the low price of printed fabrics the necessity for more expeditive and perfect methods made itself felt (see Persoz, Traité de l' Impression des Tissus. Vol. IV, p. 517).

The machine employed for this purpose is constructed upon the principle of glazing by hand already described, as follows: — It consist of two frames B (fig. 94, p. 243) formed of 2 uprights (supporting the delivering and the batching rollers, the glazing table etc.) between which is a polishing stone »A« or a circular piece of polished steel; this being fixed to a rod C of at least 4 metres long; if the rod is shorter the arc of the circle is too small, the polisher does not work well, tending to cut the piece in the middle, through »puckering«.

The polisher A is set in motion by the rod D fixed to the fly-wheel V. The machine is driven by a strap, running on pulley P. The goods are placed on the table T, which has a groove corresponding to the arc described by rod C; a rack mechanism M raises or lowers the table. The fabric advances very slowly in the direction of the machine and the polisher works in the direction of the weft; a click and spring mechanism fitted to the side of the machine and communicating with the fly-wheel, causes the cloth on the beam to advance slowly. This beam is placed in front of the machine, but is not represented in the drawing; when the piece is finished it is batched

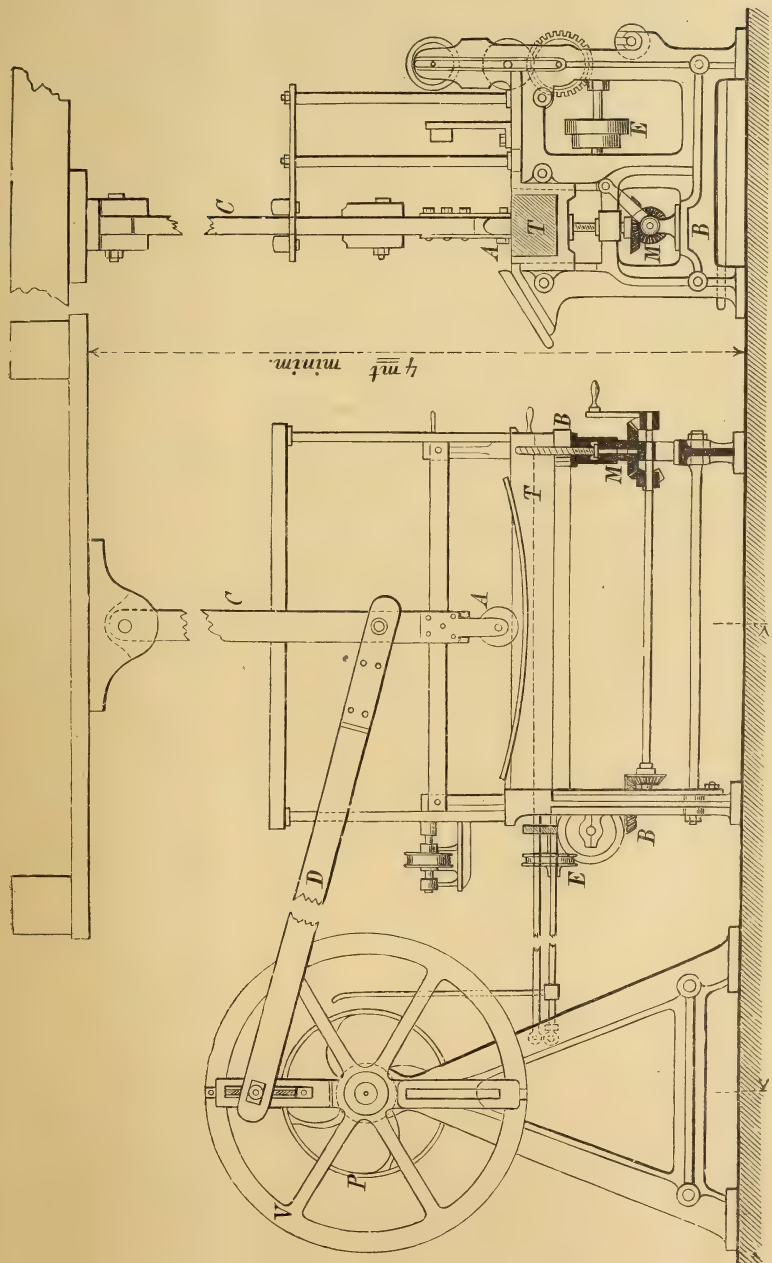


Fig. 94. Glazing apparatus.

at the back of the machine. By means of a roller in front of the machine the tension of the goods can be regulated.

After this process the goods are sometimes calendered a few times in order to obtain a higher and more even glaze. When glazing is done with the friction calender, the fabric is waxed, whilst in motion, either by hand or by a wax plate, to which to and fro motion is given by one of the bowls.

A special machine has been constructed for this purpose vide fig. 95. It consists of an ordinary batching roller, with engaging and disengaging coupling within reach of the workman. In front, where the piece enters, are several stretching or scrimping bars at E to prevent creases, the piece passes under a roller A covered with wax. This roller is placed at the end of the lever L. The weight of the lever causes the roller A to rub against the piece which is thus waxed and batched at B and prepared for glazing. When the piece is not to be waxed, the whole arrangement is raised by pressing with the foot the pedal P.

According to the degree of glaze to be given the fabric is waxed two or three times.

Among other machines for glazing may be mentioned the beetling machine which gives quite a special lustrous appearance without glazing.

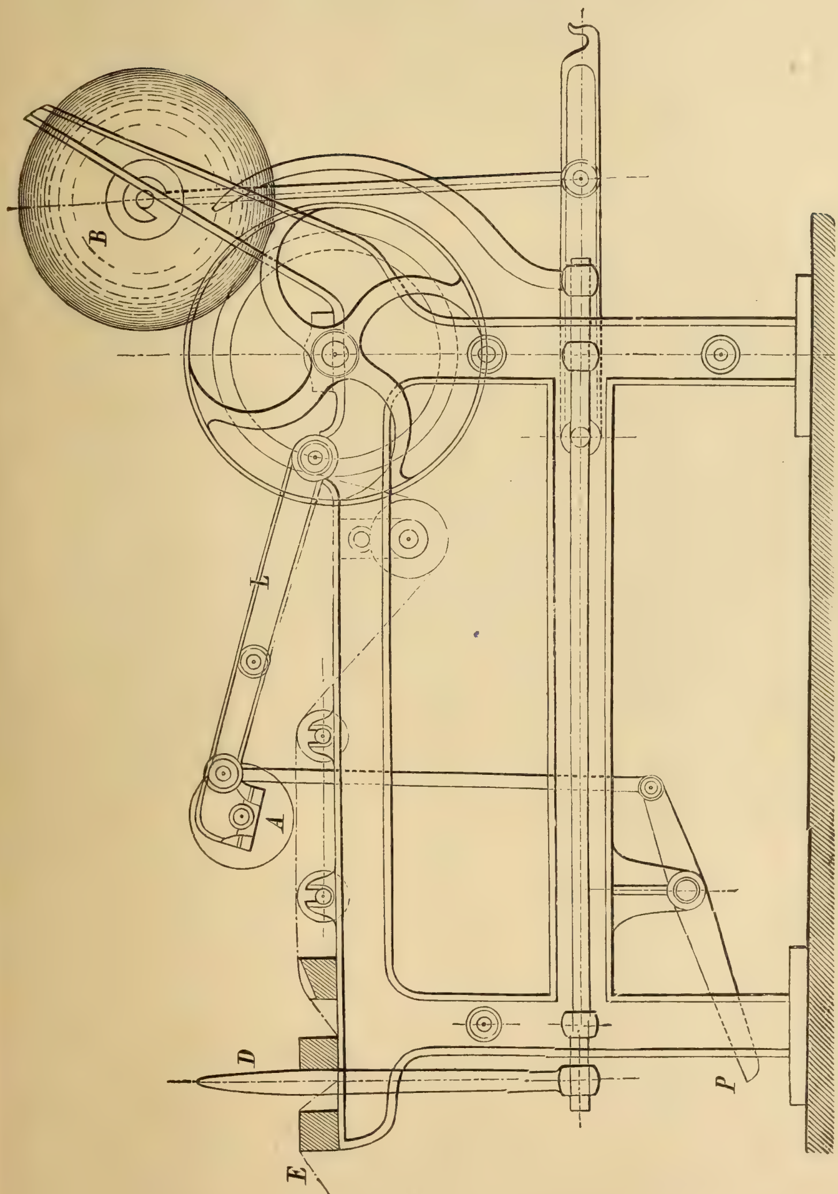


Fig. 95. Waxing machine.

BEETLING MACHINES.

The beetle of English origin was first employed in Ireland, principally for linen goods. Since 1850 it has been used for cotton and at the present day this machine is found in most finishing works. The simplest beetle consists of a strong frame, supporting a large roller upon which the goods to be treated are rolled, above are placed twenty eight fallers, see fig. 96, p. 247, these are each furnished in the middle with »noses« or projections and lifted, by the cams of the revolving shaft; this shaft is driven by side-gearing and connected with the motive power of the machine, as will be understood by fig. 97.

These cams are so disposed that each faller gives four blows for each turn of the shaft on which the cams are fixed.

When the beetle was introduced, the beam or large bowl, on which the fabric is rolled was worked by hand. It is now driven by a special arrangement, the details of which are given in fig. 97. The speed of this beam is so calculated that for each revolution the goods are beetled by all the fallers.

Subsequently two beams were used: the beetles worked on one whilst the next lot of goods were being rolled on the other.

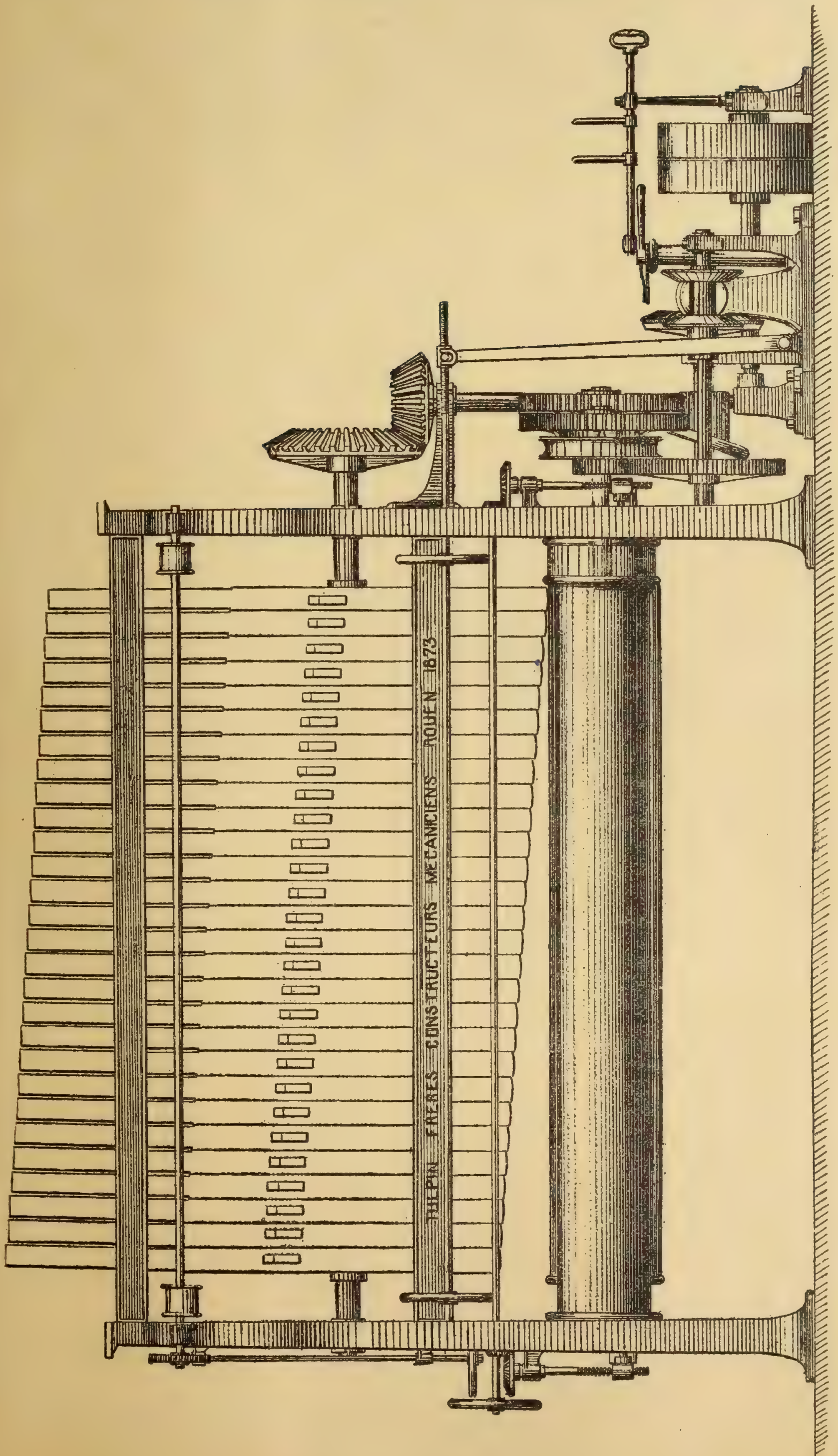


Fig. 96. Beetle.

In the new beetles which work much more rapidly, this arrangement has been modified, on the lower part of the machine a sort of moveable disc with notches has been placed; this disc or rather these discs (for there is one at each end to support the cloth beam) are moveable and are notched so as to place the three rollers at the same time; the middle roller on which the beetle acts; the roller on the outside or behind the machine is then the one which has already been in work and which can be unrolled; and the front one on which the goods are prepared during the working of the machine.

The operation on the middle roller being finished, the discs are turned — the first roller becomes the second, the second the third and another is placed in front, to be prepared. This arrangement allows a continuous action of the machine so that the pieces can be taken away and replaced without stoppages or interruption of the work.

In the ordinary beetle the fallers being of very thick, hard close-grained wood and covered with lead, flatten the cloth and give it a certain appearance and a peculiar feel and suppleness. Attempts have been made to increase the speed and production. *Mather and Platt* have invented a machine, dispensing with cams and fallers, and working with eccentrics.

This machine, as shown in fig. 98, page 250 B, has three cast iron beetling beams, revolving cast iron discs, and is made with any number of hammers up

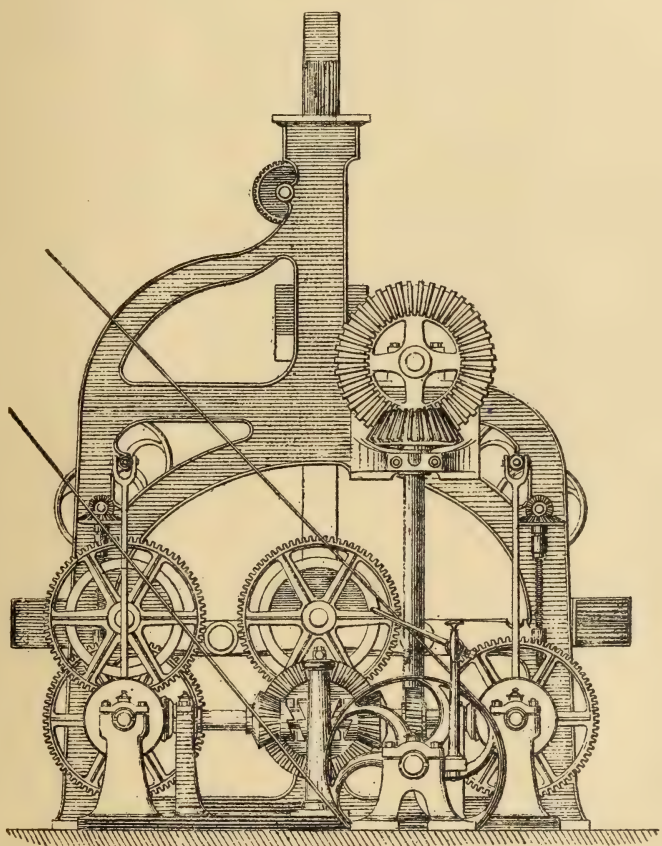


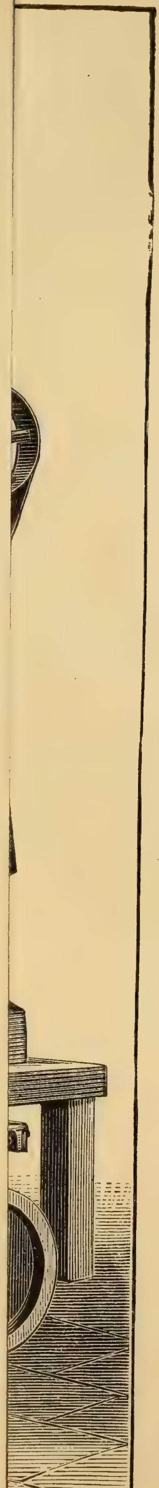
Fig. 97. Beetle. Side view of the machine.

to twenty eight. Whereas the beetle previously described could only strike 60 blows per minute, the hammers of this patent Beetle give elastic

blows to the piece with great rapidity (450 blows per minute) and every variety of beetle finish may be produced more economically than by the old and slower methods. One of these machines with 14 hammers does as much work as seven ordinary Beetles with wood fallers raised by cams, further it requires only 6 HP instead of 15 to 16 HP, and takes up much less space; viz: 12′ 6″ by 5′ 6″ by 10′ 0″ in height.

In the first machines of this kind the hammers followed the movement of the eccentric and were consequently wanting in elasticity, however, they are now furnished with semi-circular steel springs, provided with leather straps, on which the hammers are fastened; the shocks and rebounds so hurtful to the machine and fabric being avoided, for sharp quick blows cut the fabric.

Beetles have been variously constructed and improved. Without further examining all these machines, which often differ only in the details, and having described the best systems employed at the present time we will summarily mention the principal modifications: *Chambers* (1854) made the first metal hammers, *Buchanan* arranged two beetling beams, and made each hammer with two heads, thus giving two blows at one stroke. *Auchinclos* tried to replace fallers, by hammers working like the beaters in washing machines. *J. Smith* in 1863 tried to give elasticity to the hammers by providing them with springs. This



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construction was taken up by *Patterson* and improved by *Mather and Platt*; as represented in the drawing fig. 98, page 250B.

The latest patents relating to beetles are by *Connor* (1874), and *Gartside* and *Bradbury* (1875).

MANGLES.

In finishing on calenders the cloth passes through continuously, and receives its finish direct in single ply whereas in chest mangles the action is quite different; the cloth is rolled up and the movement given to these rolls of cloth is alternate, so that the great pressure, from the weighted chest, exerted, and the superposition of two threads, produces irregularities.

This gives a certain appearance caused by one thread being on the other or by its being over a space or interval between two threads, or again by two spaces being one above the other. These varieties of pressure give a particular appearance to the fabric, which cannot be obtained with any other machine. We have previously seen that, by calendering pieces one on the other, a similar effect is produced, but it is not equal to that obtained with the mangle.

There are several kinds of mangles: the most ancient is the one called the German or chest mangle, which is often preferred (fig. 99 and 100,

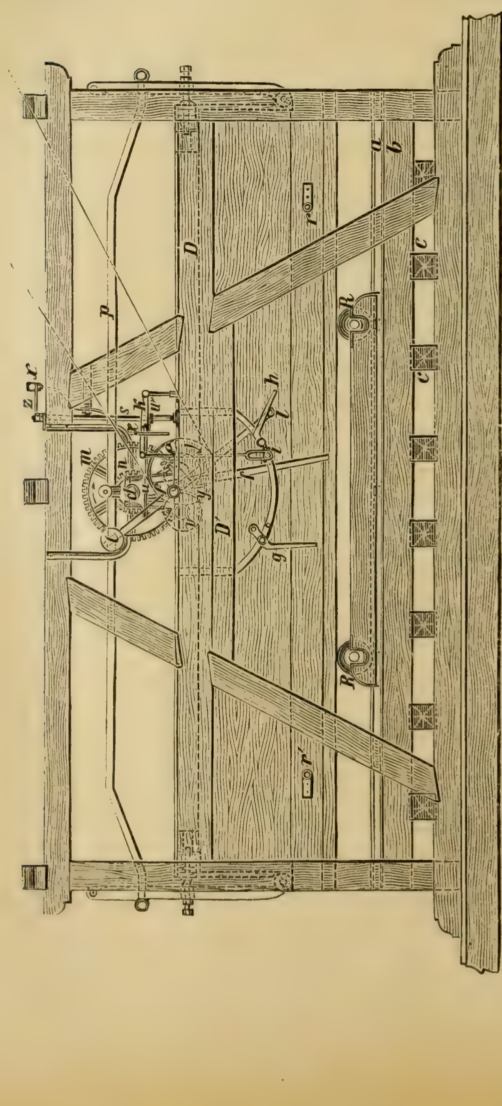


Fig. 99. Side view of mangle.

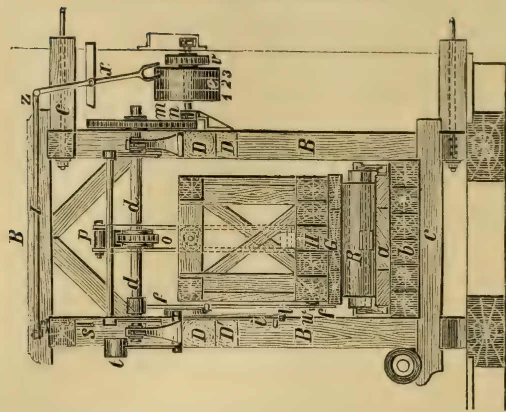


Fig. 100. Front view of mangle.

page 252) it consists of a very smooth wooden or cast iron plate a, fastened to beams b placed side by side, which are supported by transversal beams c, c. The whole must be erected on solid masonry, as the mangle being very heavy and receiving many shocks must have a good foundation to keep the plate a always in the same horizontal position. At r is a kind of frame in which are placed the rollers on which the piece to be mangled is rolled. D D (fig. 99) are transversal pieces of wood, which connect the body of the framework and are attached to beams B B B. The chest H G is also of wood and very solidly made; it is filled with paving stones or old iron. The load for a mangle of ordinary dimensions, that is about 10 m. (11 yards) for the length of the plate a, placed at 1 m. ($39^3/_8''$) from the ground and 2 m. ($6{\cdot}6'$) wide, is from 20 to 30.000 kilos (20 to 30 tons). The chest is from 6 to 7 m. (7 yds.) long, or even 8 m. (9 yds.) long by 85 centim. ($33^1/_2''$) wide, and 1 m. 10 centim. ($3'$ $7''$) high.

Fig. 99 and 100, page 252, show this mangle drawn to a scale of $^1/_{50}$ (that is 1 centim. representing 50 centim.).

Fig. 99 shows where the piece to be mangled enters.

Fig. 100 gives a front view of the machine, which is placed at 50 or 60 centim. (20 or $23''$) from the wall, supported by joists marked C.

The mangle is set in motion by arm Z; three pulleys E, marked 1, 2, 3, effect the alternate backward and forward motion of the box; there are two straps, one open, one crossed; working together, and the mangle is at rest when straps are on the outside pulleys 1 and 3 which, although represented in our drawing as being of the same width as Nr. 2, ought to be twice as broad. The driving and reversing gear has a double fork, not shown in figure for the two straps; by drawing this towards the machine, the strap nearest the wall will pass on to the middle pulley and give the movement in one direction, if this action be reversed, the straps go towards the wall; strap 3 returns on loose pulley, whilst the strap of pulley 1 passes on pulley 2, and gives to it an opposite movement.

Two wheels m and n give motion to shaft d which carries a toothed wheel for working the chain fixed to each end of the chest. f is the principal disengaging lever; g, h, i, are the guide pins for starting and stopping the mangle. When f is in the middle the apparatus is at rest.

The mangle is used principally for white and dyed goods, indigo (blue dip) styles, also for giving an imitation linen finish.

The operation of calendering in the mangle is somewhat delicate, and must not be overdone as the enormous pressure to which it is subjected will deteriorate the fabric.

It is important for the fabric to be thoroughly and evenly damped. For ordinary calendering it must be mangled 4 or 6 times; to obtain a good »moiré« as many as 16 »manglings« are necessary.

The cloth is batched full width, or folded and then rolled up. The result is always better when the fabric is doubled; the »watering« or »moiré« is more accentuated and the water lines more effective which is very important.

With an ordinary mangle 12 pieces of 100 m., passed 16 times in ten hours, is the maximum of work which can be obtained. Other mangles which we shall describe produce double.

Large or small cloth rollers in iron or wood are employed, according to the finish to be obtained. The finest lustre is obtained with large wood rollers; small ones give a little more lustre but less »water« or »moiré« effect.

It is essential to roll the goods very tightly and evenly, also to put on the roller before batching, a strong material or lapping and cover the fabric when rolled up with lapping.

Although the chest mangle gives superior results, it has serious drawbacks; it occupies much space, requires great motive power, often needs repairing on account of the shocks, occasioned by the backward and forward motion of the chest,

and lastly its construction and fitting up are very expensive.

Efforts have been made to replace it by a rotary mangle, this requiring less space and very little repairs, being constructed entirely of metal; the movement is regular and the working of it much easier than the chest mangle. Lastly with the rotary mangle the speed and pressure

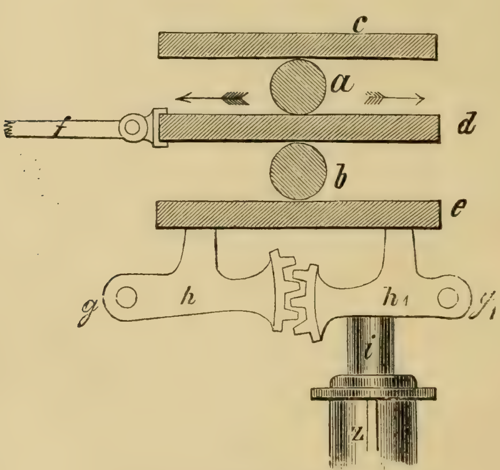


Fig. 101. Horizontal hydraulic mangle.

can be regulated which cannot be done with the ordinary one.

We will commence with the hydraulic mangle.

The first hydraulic mangle was invented by *Kaselowski* (Prussian patent of 1850) fig. 101, page 256.

It consists of an ordinary hydraulic press Z, provided with a plate e, and a table c, between

which works a horizontal press-plate d, moved to and fro by the piston-rod f, of a horizontal steam engine; between the plate d, and the two tables c and e the rolls of cloth a and b to be mangled are placed. The piston of the hydraulic press acts on two cog-geared arms h h′, moveable at their axis g, and arranged to accommodate varying diameters of mangling rolls.

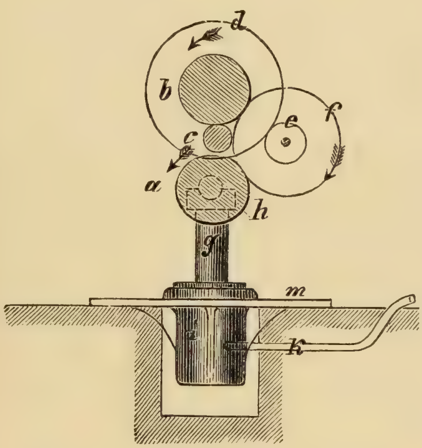


Fig. 102. Circular hydraulic mangle.

With this mangle a pressure of more than 100.000 kilos (100 tons) can be given; excellent results with fine goods are obtained but, however manipulated fine »moirés« cannot be produced: it gives more of a glaze than a moiré.

Thus it has been somewhat abandoned and is generally replaced by circular mangles, which are of several systems.

Some (fig. 102, page 257) of these have a pressure bowl H, worked by a hydraulic press g, fixed in a frame m, and receiving the water by the pipe k; above the cloth roll c is a second

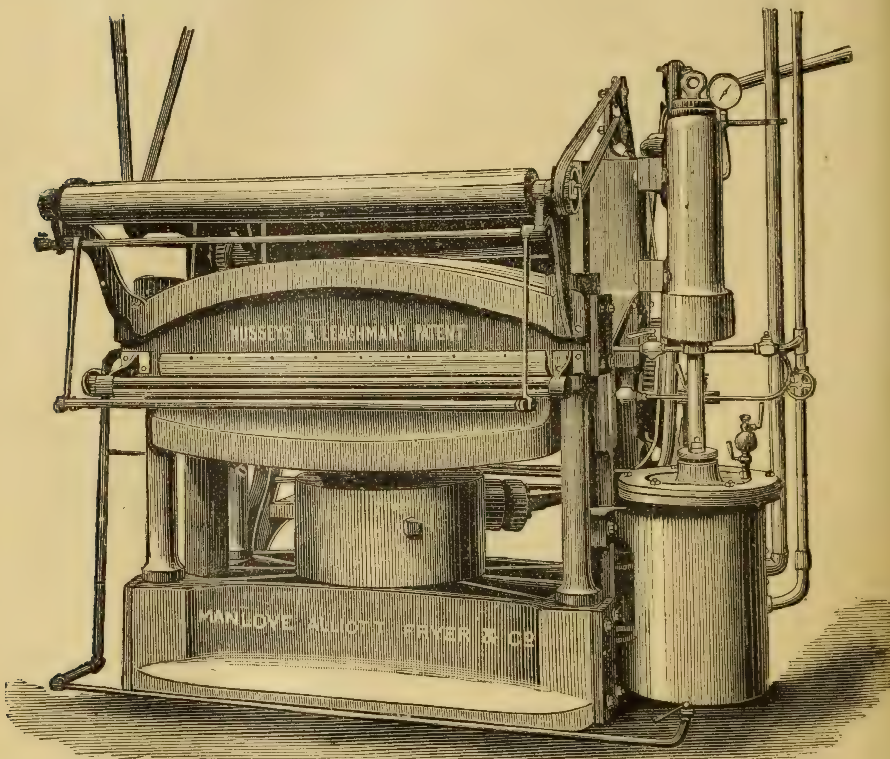
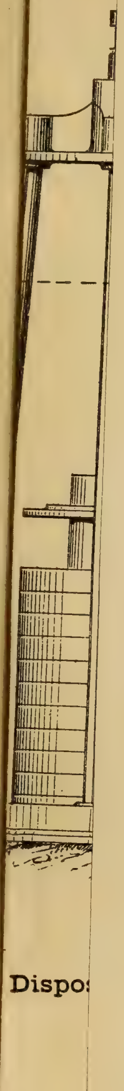


Fig. 103. Double acting hydraulic pressing machine.

fixed pressure bowl b, driven by pulley f through wheels e and d. Another and improved system is *Nussey & Leachmann's* patent hydraulic pressing machine (fig. 103, page 258); this machine is



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double acting and offers great advantages being complete in itself; it is principally used for woollen cloths, worsted stuffs etc.

Pierron and Dehaitre construct a mangle in which there are three pressure bowls, the two bottom bowls are fixed (see fig. 104, 105, 106, page 258 B) and the top bowl alone receives the hydraulic pressure. It is so arranged that its height can be modified.

The three figures (104, 105, 106, page 258B) explain the details of this machine which is provided with a strong buffer spring at the bottom. This mangle is fitted with a set of pulleys for different speeds, as well as to work in a given direction.

A rotary mangle, much employed at the present time is that of *Deblon*; it works by hydraulic pressure and very rapidly, giving excellent results; it can be worked in any direction and is provided with a manometer, indicating the working pressures.

These calenders and hydraulic mangles withstand considerable pressure.

A few years ago we indicated the method of calculating the pressure exerted in printing machines. (See *Bulletin de la Société Industrielle de Rouen* 1876. Rapport sur les presseurs garnis de caoutchouc de *Letellier et Verstraët.*) [Report on pressure bowls covered with india rubber.] In calenders the conditions are quite different:

the pressure acts from the top and is complicated by the weight of the paper bowls and their lappings.

In a simple 2 bowl calender both bowls running at the same speed, where the piece passes directly without any action but that of the weight of the top bowl, the calculation is as follows:

P^S the surface of pressure,
L the length of the pressure bowls,
B the arc of contact of surfaces pressed we have:
$P^S = L \times B$.

Let $M =$ the average pressure and $T =$ the total pressure

Then $T = P^S \times M$

or

$$M = \frac{T}{P^S} = \frac{T}{L\,B}.$$

In this case, which is the simplest, the diameters of the bowls and the thickness of the fabric play a certain part. The point of contact will be so much larger (and consequently the arc of the contact of surfaces) in proportion as the bowls are larger and the fabric more elastic. These considerations are purely theoretical; in practice, the surface of contact is not admitted as an actual surface; but simply a line, representing

the length of the calender is considered, and it is on this line the pressure is exerted.

In a 3 bowl calender the pressure on the bottom bowls is generally greater than that on the top bowl. The levers act equally, but this action is increased by the weight of the top bowls on the bottom ones, this being sometimes considerable.

Suppose a calender with a bottom bowl A weighing 450 kilos, a second metal bowl B weighing 750 kilos (1653 lb.) and lastly the top bowl C = A = 450 kilos (992 lb.).

If we weight the levers with K kilos on A including the weight of B + C, the pressure between B and C will be K + C and the pressure between B and A will be equal to K + (B + C) on a length L.

If in the preceding example we substitute figures for letters and take a length of 1 m. 20 ctm. ($47^1/_4''$) we shall have, by putting 2.000 ks. pressure on the two levers, a lineal pressure per centimetre represented by

$$\frac{2000 + 450 + 750}{120} = 26{\cdot}6 \text{ K}^{\text{os.}}$$

$$\text{or } \frac{4411 \text{ lbs.} + 992 + 1653}{47.25} = 149 \text{ lbs. p. inch.}$$

Under ordinary conditions, it is admitted that the normal pressure exerted on the fabric passing between the first and second bowls of a 3 bowl calender is about 35 kilos per lineal centimetre (or 195 lb. pr. lineal inch.).

WATERING (MOIRÉ) AND EMBOSSING.

Watering is the operation by calendering which gives a particular moiré or wavy silk appearance to a fabric and is produced by a variety of undulated reflections and plays of light on the threads. When a fabric is uniformly pressed, it becomes glazed, but when one thread is glazed and the next one unpressed the moiré effect is obtained. This effect was known to all antiquity, by uncivilized as well as civilized nations. The former produced the watered appearance by superposing two fabrics and striking them with a mallet. The watering is obtained in different ways:

1 st. By superposing two pieces of the same fabric, or folding the same piece and passing between two bowls of a calender. (See page 228.)

Also by »jacking« or batching the piece on the fourth bowl (fig. 81, page 225).

2. By rolling the piece up and subjecting it to the great pressure of a heavily laden chest moving to and fro over it as the mangle described p. 253.

3. By passing the goods through a calender with one of the bowls engraved straight round with fine lines and the other un-engraved, a to and fro, or vibrating motion is given to the cloth in passing through.

4. By pressing or embossing the goods with an engraved roller of the moiré design desired.

Sometimes in embossing, two engraved rollers are used, one with the design in relief, the other with the same design intaglio; in this case precautions must be taken to avoid spoiling and cutting the fabric. The engraving should not have any sharp outlines and the stiffened cloth should have a certain suppleness to yield to the pressure.

The machine employed besides those already described, is the embossing calender represented in fig. 107, page 266, which is similar to a calender. It can be heated by gas, »bars«, or steam. In our drawing the heating is shown by gas; the middle bowl represented as plain, is engraved. There is an arrangement in front (not shown) for giving the to and fro (moiré) motion to the piece.

It will be understood that not only moirés but all sorts of designs or effects in relief can be produced by embossing; such as diagonal slash lines (silk finish) fine lines engraved suitable to the warp threads of the cloth, pins, dots, checks, sand and marble effects, figures etc. etc. Of course each such design requires its own engraved roller.

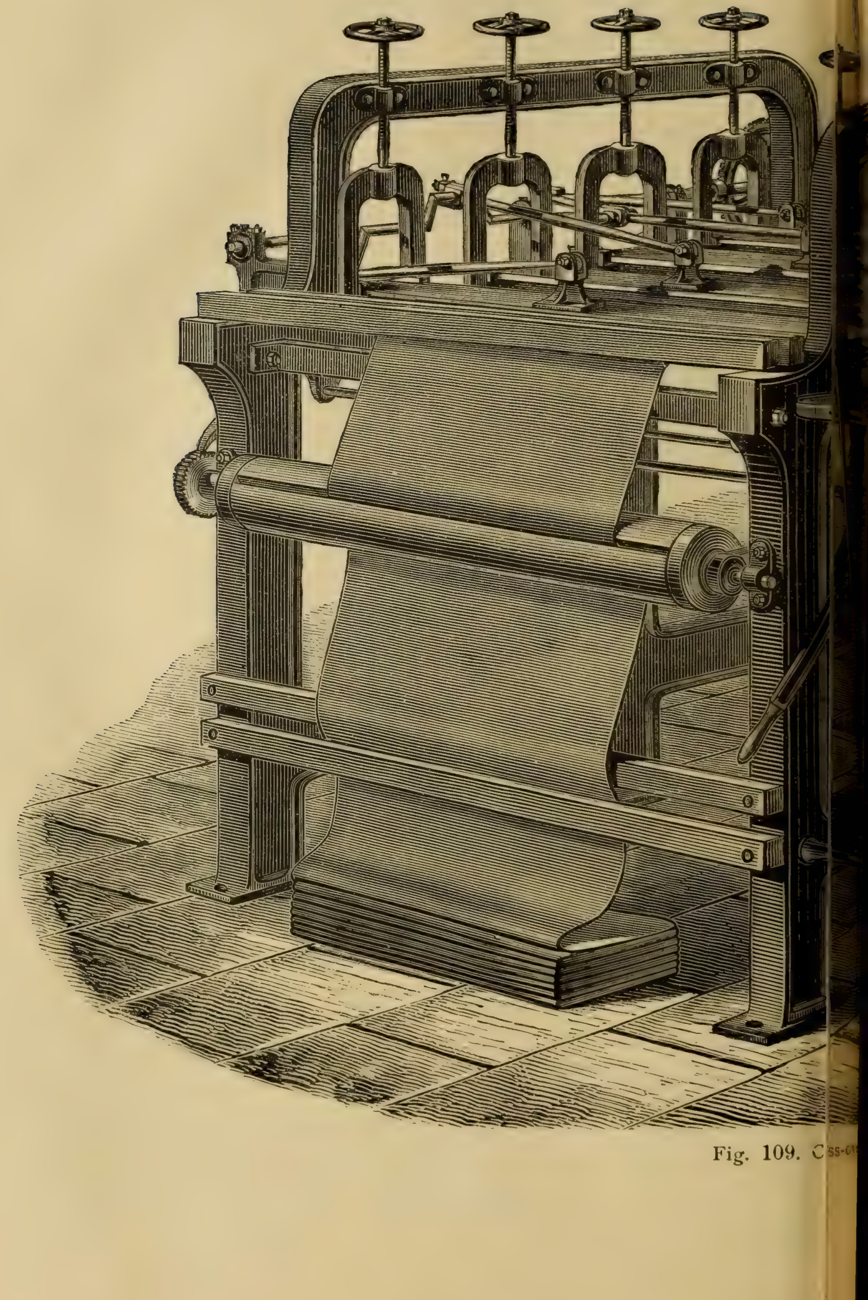
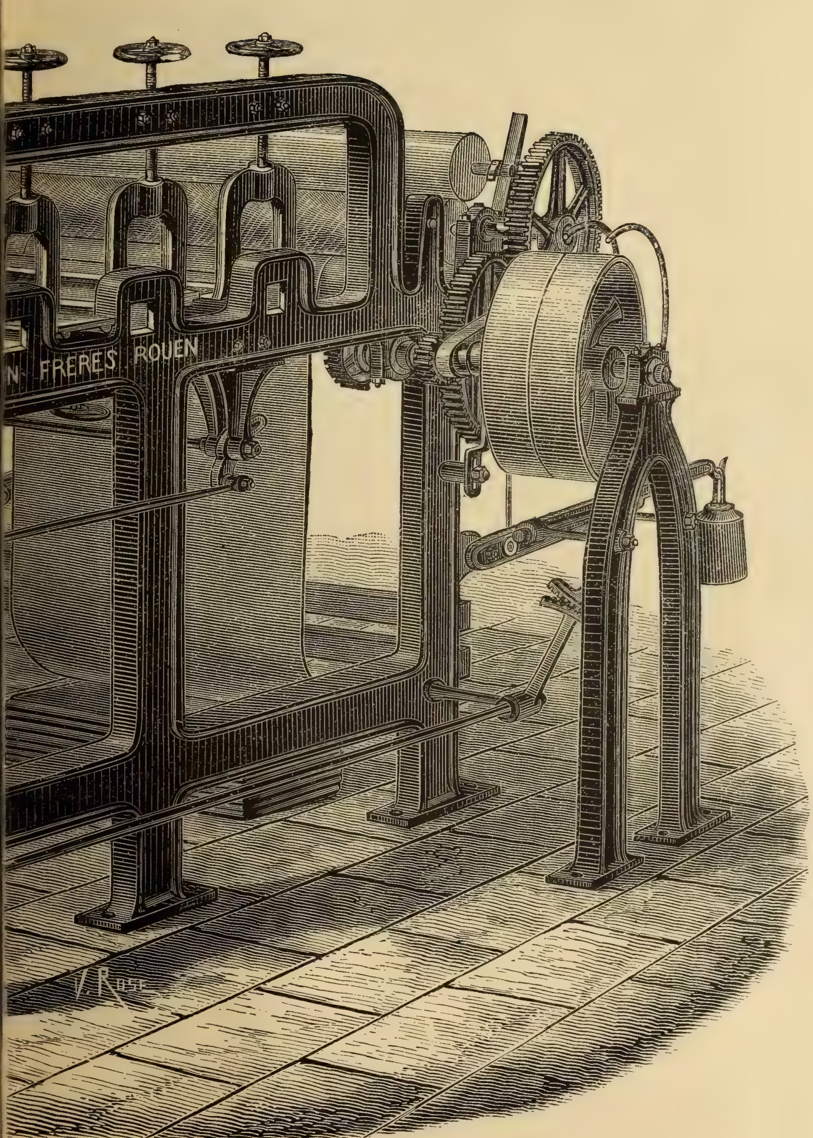


Fig. 109. C



ing machine.

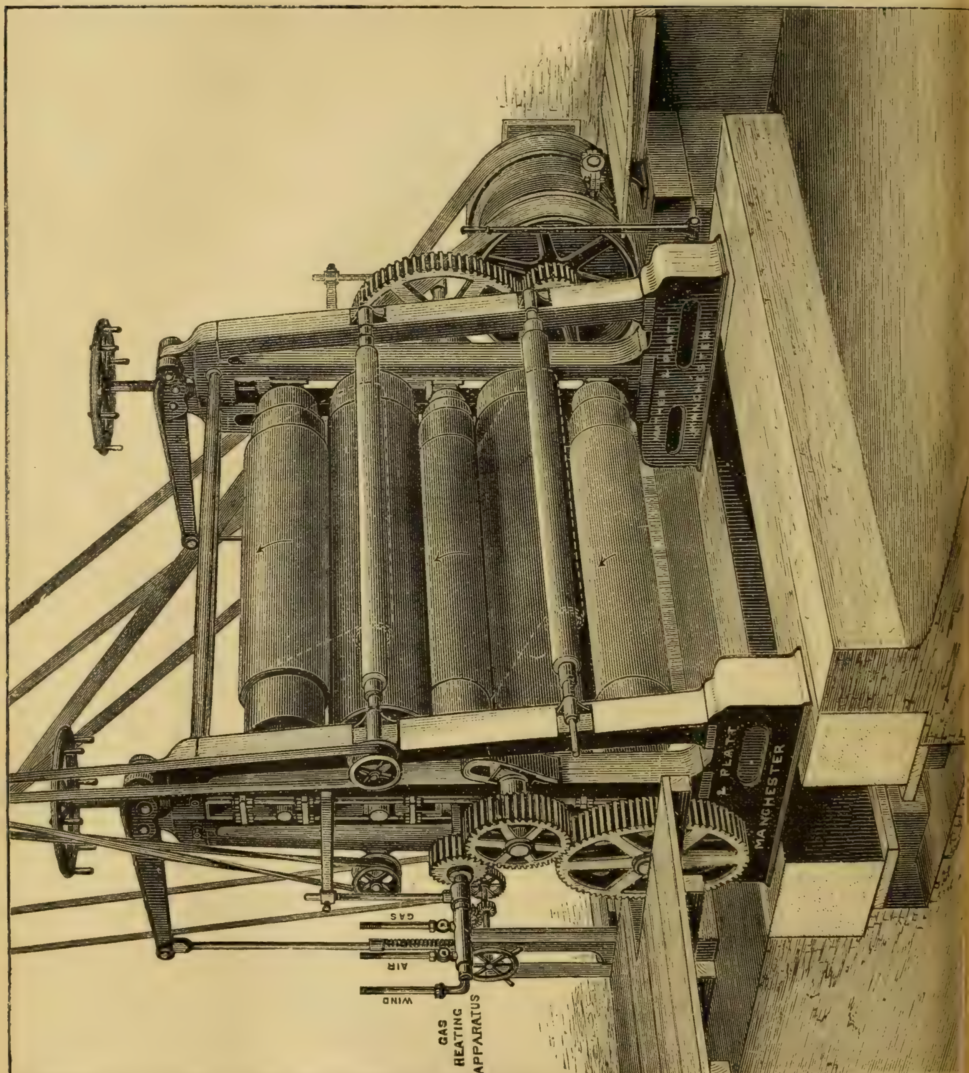


Fig. 107. Moiré and embossing calender.

Embossed and moiré goods are chiefly used for linings, bookbinders cloths, patterncard making for fans, hat manufacture, and Parisian novelties.

RAISING MACHINES, TEAZLES ETC.

The operation by which a tissue is rendered downy and woolly is very ancient. A long time before cotton was used this operation was practised on woollen fabrics; on the mural paintings of Pompei slaves are represented raising, or carding fabrics by hand.

This operation for cotton has only acquired a certain importance during the past few years. Fabrics thus treated no longer belong to the ordinary styles, and constitute a speciality. We shall not enter into the details of all the invented raising machines, but briefly point out the principal kinds employed in finishing, without dwelling on the special apparatuses intended for raising unbleached goods, as this would be digressing from our subject; some general remarks however seem necessary.

Teazling was at first done by means of thistles (1). The head of the thistle was employed without any preparation; subsequently it was formed

(1) Commonly called *Thistle* or *Teasle*. It is the fuller's thistle, *Dipsacus fullonum* Mill. This plant is almost exclusively employed for raising in the manufacture of woollen cloth; its root is diuretic and sodorific.

into a sort of brush, with which the work was done by hand and later on the thistles were fastened to rollers revolving at a certain speed.

Ultimately raising cards, similar to the card clothing used in spinning mills, were substituted for thistles.

In the finishing of cotton goods raising is an accessory operation, that is to say, that finished fabrics must have been previously raised either before or after bleaching. The fabric once finished cannot be raised, if it has not been previously treated with this object in view. *The raised nap which has been flattened or injured by the stiffening must simply be restored.* This is a special operation in finishing. It consists of lightly brushing up the nap; we may observe that in cotton fabrics one side is generally smooth and dull, and which bears either the woven design, as in Piqués, Brilliants, Dimities, »Jacquards« etc.; or the printed pattern as in flannels, swansdowns, half twills etc.

On the contrary in beavers, beaverteens, fustians, velvets etc., the nap or pile is on the right or printed side and is obtained by raising, and this combined with the printing operations gives a special appearance to the fabric.

If a white tissue be printed with a pattern of any color and then raised, its intensity will diminish and the printing will lose its clearness; if a second colour be printed over the first, the second will become more intense and the first

will form a ground, the effect of which is very difficult if not impossible to reproduce.

The raising machines most generally employed for the finishing of cotton goods may be divided into three classes

1st Circular machines raising lengthwise.

2nd Diagonal raising machines.

3 d Crossover raising machines.

This classification is based simply on the mode of action of the card on the weft.

The amount of contact of the fabric with the raising cards is of course independent of the system employed: this depends on the number of rollers (two, three, four or more) and also the amount of contact.

The simplest apparatus of the first class is *Thomas'* raising machine. It consists of a drum b, furnished with cards (fig. 108, page 270) over which the fabric from roll d passes and is wound again on to c; the axles of c and a are geared to that they can turn in both directions. The fabric h, passes over the guide rollers f and g at a tangent to the raising drum. These guide rollers can be adjusted to give more or less contact.

Raising machines of various systems have been constructed. The one represented is the simplest and best for finishers. However for white fabrics the Cross-over raising machines are often preferred. The simplest consists of a frame in the shape of

a right-angled triangle; the hypoteneuse carries the raising rollers connected with each other and driven by the same motion; the first and fourth work in the direction of the length of the piece (warp) the second placed at an angle of 45° raises

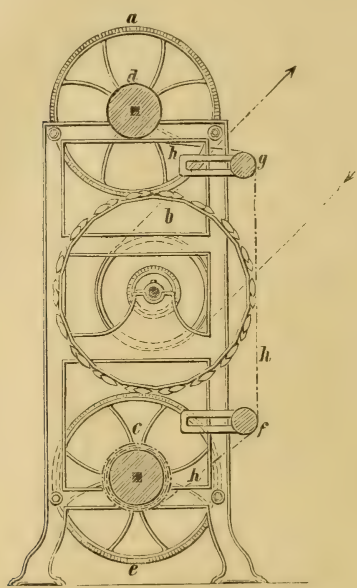


Fig. 108. Circular raising machine.

towards the left, the third at 45° to the right, acts perpendicularly to the second.

The under cathetus acts as a general support for the machine and the vertical side, supports the batching roller. The cloth beam is in front of the machine.

Cross-over raising machines generally consists of a frame with batching apparatus, gearing etc.

The cards are fixed to thin boards each provided with a link motion and connecting rod, driven by a set of eccentrics or cranks from the gearing of the machine (fig. 109, page 265).

Our drawing has four cards which raise alternately from right to left and from left to right.

Besides raising machines brushing machines are used for removing the fluff and dust caused by the cards. They generally consist of a batching apparatus or canroy arranged to give a long interval between the unrolling and rolling up of the fabric. Rather hard brushes acting on the fabric and revolving at a certain speed are placed above and below the fabric. (See Impression et teinture des tissus, Rapports sur L'exposition universelle de Paris 1878. *E. Lacroix*, p. 409, 410.)

Recently special apparatuses for raising goods have been recommended. Experience, the only judge in such cases, will prove and decide their worth, meanwhile we draw renders' attention to the full description of them in *Dingler's Polytechnisches Journal* 1886. Nr. 1640.

WINDING-OFF, ROLLING, LAPPING, DOUBLING, PLAITING AND MEASURING MACHINES. HOOKING FRAMES ETC.

When the goods have been calendered, glazed or raised they are far from being completed, but must still undergo other operations, which although not acting on the fabric, assist in transforming it into finished or *merchantable* goods such are the operations of doubling, measuring, pressing, making-up etc.

The piece, completed as far as finishing is concerned, is unrolled; to effect this the roller on which it is wound is placed on an iron bar, and the fabric is wound-off by passing it over two little rollers fixed to the ceiling, thus any defect in the piece may be discovered.

In some works a heavy tripod is used provided with swivel rod arrangement whereby the batched roll can easily be fixed, wound off, and measured by the rectometer.

When the piece is to be wound-off for examination the apparatus fig. 110, page 273, or the one represented in fig. 111, page 274, is used.

The piece passes slowly between two rollers as shown, a measuring motion is attached by means of worm and angle wheel the finger indicating the length (yards or meters).

Sometimes a simple measuring apparatus is used, which is placed on the table where the fabric is wound off by hand: the traction of the cloth puts in motion a toothed wheel which communicates with a counter, indicating the number of metres, or yards etc.

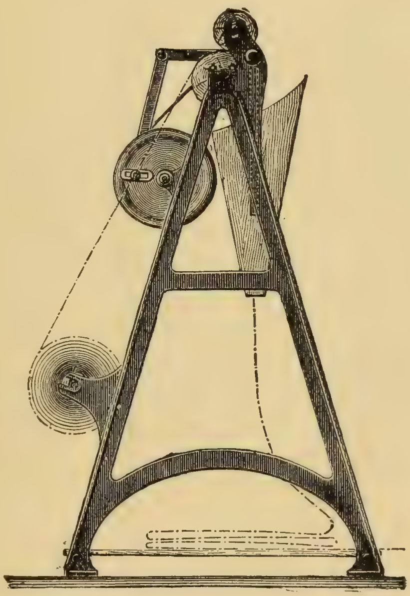


Fig. 110. Winding-off machine.

Sometimes the fabric requires to be doubled or folded in a certain manner before being measured, in which case various methods are employed. The simplest and most frequently employed, but the slowest, method consists in winding off the piece and doubling it by hand on the table, and

then measuring it. The process can also be performed as follows: place four perpendicular rods on the table, their base representing a rectangle,

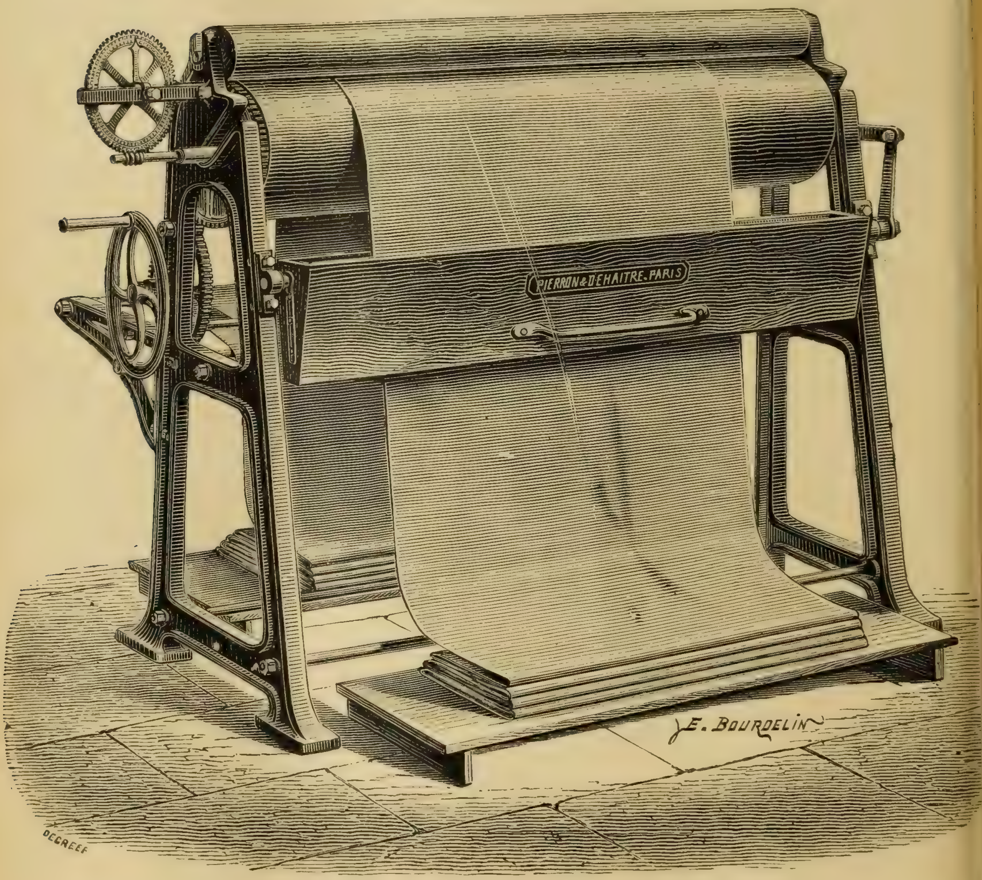


Fig. 111. Winding-off and measuring machine.

the long sides of which correspond to the length to be given to the folds of the piece, and the short sides to the width of the piece itself. If a

piece be unrolled, doubled by hand, and placed on the table, the first metre or the first length will cover the surface contained between the four rods; if a rod be placed beyond and across one of the sides in the direction of the width and the fabric be folded upon itself a second fold will be formed and kept in place by a second transversal rod, placed at the other extremity of the rectangle, and by continuing to place rods on each side of the rectangle, the whole piece, already doubled, will be folded and the rods are then withdrawn. This method is much used for heavy goods. Other cotton fabrics are doubled by doubling machines of which there are a number of systems.

Fig. 112, page 276, represents an apparatus invented by *Pierron and Dehaitre* in which the piece passes over a triangular framing which guides it; the movement of the machine forcibly effects the folding. When doubled the fabric passes to a second machine placed perpendicularly to the first and provided with straightening bars and a folding system after which it can be measured.

Farmer has constructed a simpler doubling or rigging machine fig. 113, p. 277. The doubling is done in the usual manner by means of a creasing cutter the cloth being placed at right angles with the guide rollers. The cloth is drawn by a pair of draw rollers over a measuring drum and folded on to a table ready for the rolling or lapping machines.

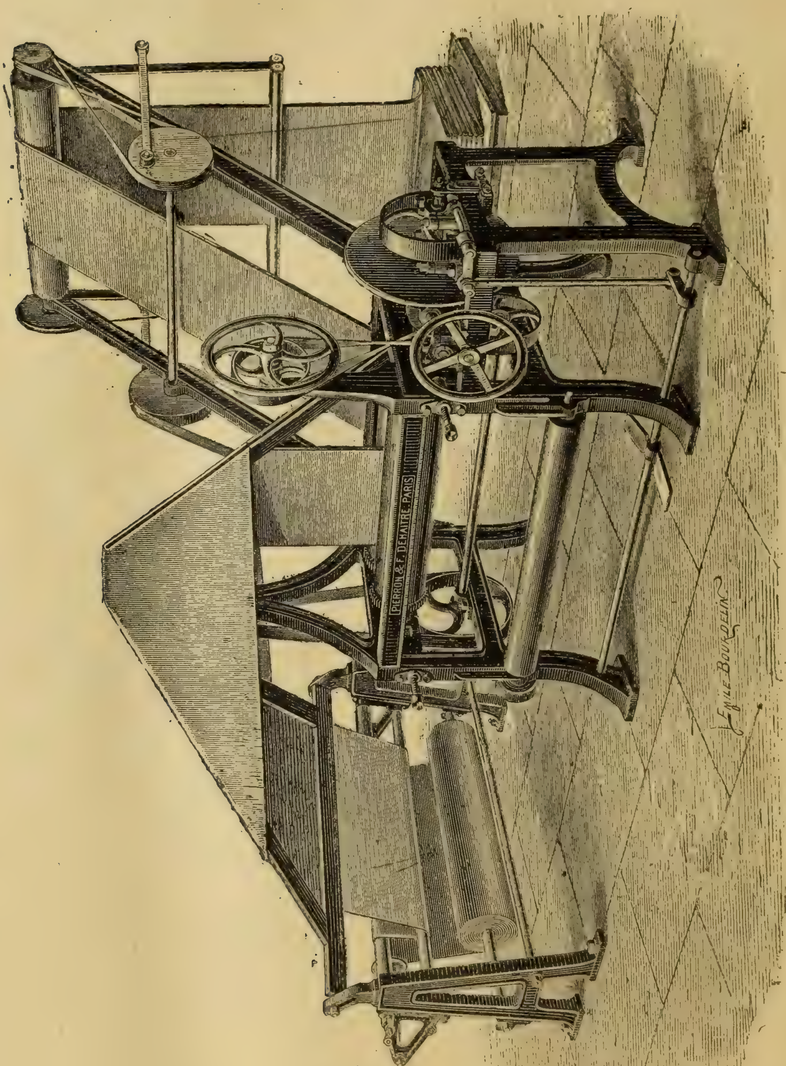


Fig. 112. Pierron and Dehaitre's doubling machine.

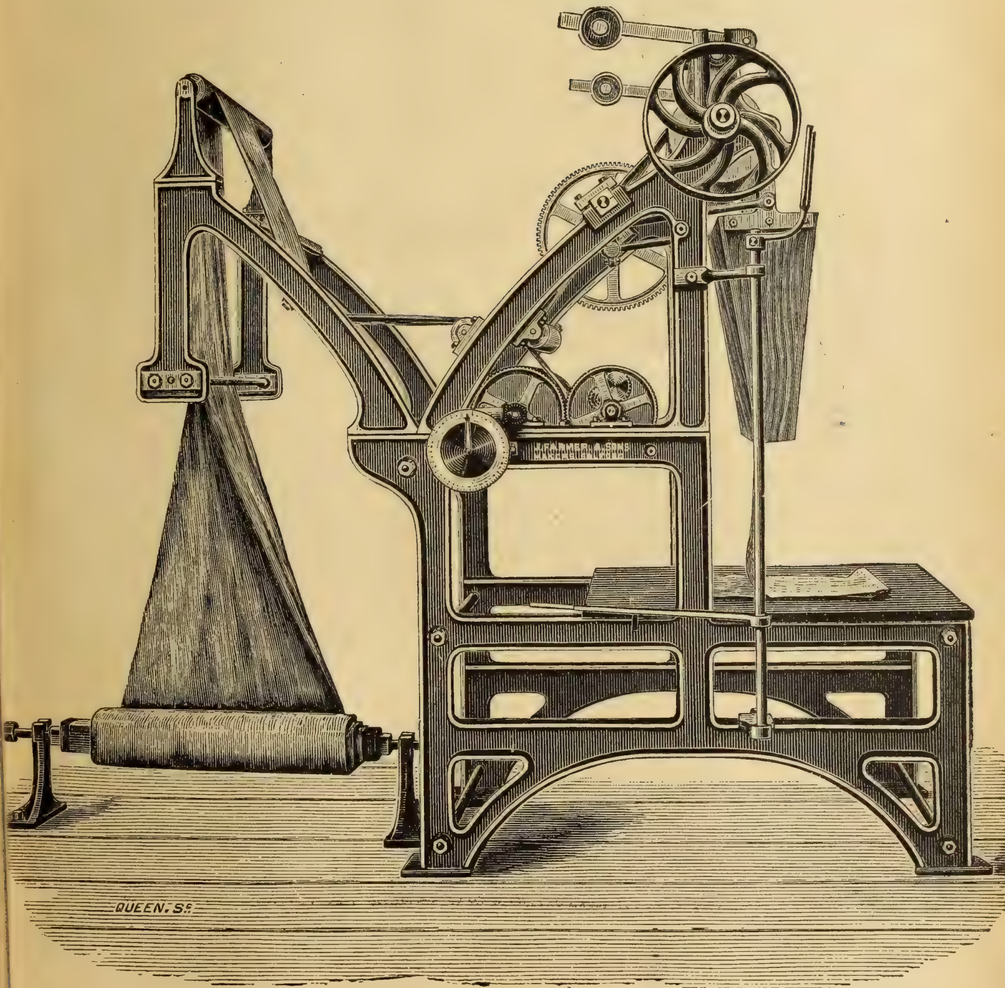


Fig. 113. Farmer's doubling machine.

A very useful improvement has been added to the measuring apparatus. It consists of a patent marking arrangement, by means of which the fabric has its length printed on the margin at equal intervals beginning, say at five yards or metres and marking consecutively up to 100 yards or metres.

Merchants greatly appreciate this marking which generally has to be done by hand at great expense, as it shows at first sight the length left on the roll of cloth. Elder's and Gebauer's doubling or rigging machines work in a similar manner but without the marking mechanism.

The following is a very simple method: the piece to be doubled is unrolled on a table of ordinary length, at the delivery end the table is cut so as to form an angle of 80⁰, the folds of the piece come near to each other as they fall down and are carried along by two winding-on rollers placed below and at a certain distance to facilitate the doubling process.

Crowells American machine is constructed on this principle, but instead of a simple triangle placed at the extremity of the table, there is in the centre of the machine a triangle, the apex of which is directed towards the delivery end. To each side of the triangle except the base, are fitted, according to the width of the fabric moveable guide rods. The piece well stretched by draw rollers, passes over the table, is doubled

and then carried along by the delivery rollers. The goods after doubling are rolled up on rollers or lapped on thin boards or swords. For Cachemires, Woollen goods etc. this operation is still done by hand, as follows: the doubled piece is placed on the floor beside a long table to one end of which a rod furnished with needles is fixed, the cloth attached to the same is spread out full length of table and lapped on the sword whilst tightly stretched. For linings, white goods etc. this operation is now performed much quicker and cheaper mechanically. Such a lapping and rolling machine is shown in fig. 114, p. 280; it can be worked by hand or power; two clips hold the sword on which the piece is lapped as it comes from the binding rollers.

According to the kind of fabric the swords or plates are made of wood, cardboard or metal. When the piece is lapped the clips are released by set screws, sword taken out and replaced by a fresh one, and so on.

So far we have supposed the piece to be doubled exactly, that is to say, that both sides were of the same width, but it frequently happens that, in order to meet local or consumers requirements, instead of doubling the piece exactly, one side has to lap over the other, for instance 55% against 45% of total width. This in France is called »avantager« as the pieces appear wider than they are.

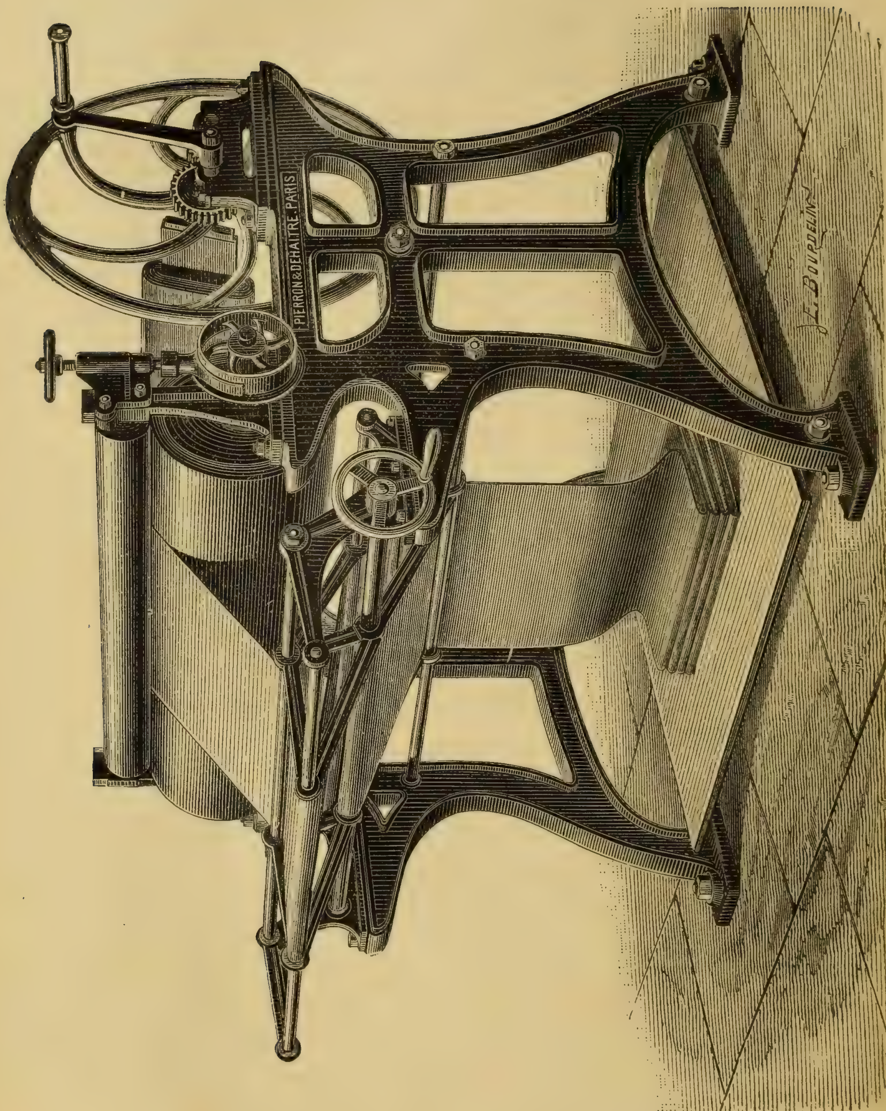


Fig. 114. Lapping and rolling machine.

»Avantager« must not be confounded with »Alsacer« which is quite a different operation.

When it is desirable to get as nearly as possible the original width of the fabric, it is stretched two or three times on the stenter and in Normandy this operation is called »Alsacer«. The Alsace goods being wider than those of Rouen, this operation is performed on the latter to make them appear of the same width as those of Mulhouse (Alsace). To »Avantager« a fabric is to give it a more presentable appearance whereas to »Alsacer« a fabric is to alter it to the disadvantage of the buyer. The so far completed goods now require to be measured by hand or machine.

The simplest process consists in hooking the fabric on steel needles, placed at certain distances and fixed to a frame so that the fabric is suspended and not soiled. This primitive method is however principally used for greycloths, the hooks making large holes in the fabric and puckering the selvages.

The most practical, reliable and simple apparatus for measuring is the rectometer. It consists of a trestle or frame with an arm at each end carrying a small square steel or cast iron rod on which move small rectangular bronze plates. Fig. 115, page 282, represents one of these arms. Figs. 116 and 117, page 282, show the arrangement of each of the plates placed on the right or left of the rectometer. These plates are numbered, so that the workman need not count the metres

or yards measured. Adapted to one side of frame a disengaging catch facilitates the unhooking of the piece. The manipulation of this apparatus is very easy and requires no further explanation. A good workwoman can hook from 40 to 50 pieces of 100 metres in a day of 10 hours, provided the goods have been previously examined to prevent loss of time.

Folding and measuring machines produce large quantities, but the goods never have the appear-

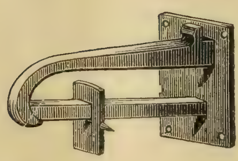


Fig. 115.

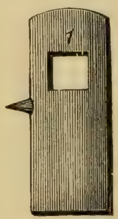


Fig. 116.

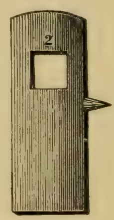


Fig. 117.

ance of those folded on the rectometer, moreover by the former process errors in measurement, prejudicial to the seller as well as to the buyer, may easily occur.

Fig. 118, page 283, and fig. 119, page 284, represent two systems most generally in use. In some machines the table on which the fabric is folded, is flat, in others it is curvilineal. In the two machines represented the tables are curved. Flat tables are often preferred as the piece does not slip so much and consequently not so liable

to be displaced, this causes loss of time as the irregular folds have to be rectified.

In Hummel's machines the holding rails are covered with woollen cloth and the table is provided with a heavy counterweight pressing the

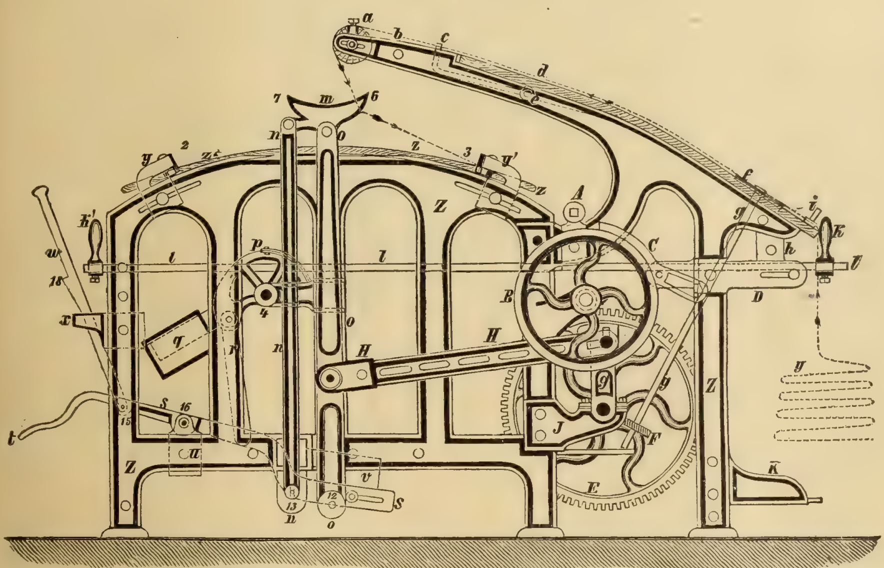


Fig. 118. Folding and measuring machine.

Z framework of machine, — z wood table on which the piece is folded and which is held in equilibrium by two levers placed on the shaft 4. These levers are provided with counter weights 9, so placed as to give the table a constant tendency to rise. — g is the fabric to be folded, and passes over the curved table a, b, c, d, f, i: and the small guide roller a. B driving pulley, gearing in wheel E, K. K' the stopping and starting gear: m, n, o, 12, 13, 7 are the plaiting down arms, which fold the piece on the table Z Z' whilst held by the holding rails y and y': these rails are covered with woollen cloth or cards. H H' rod connecting rod arms 12 m. to wheel E; F. f. g. g, measuring motion with counter; t foot lever for lowering the table Z Z, in order to withdraw the piece.

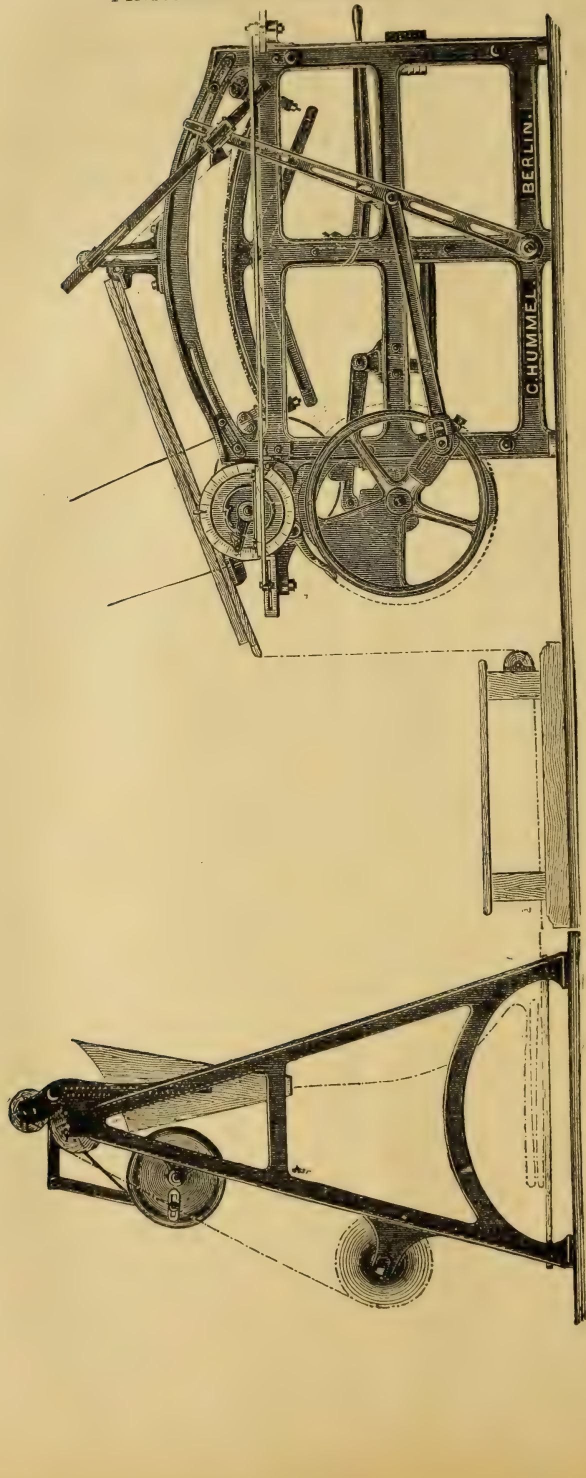


Fig. 119. Winding-off and plaiting machine combined.

piece against the rails. For ordinary unglazed goods all these machines answer very well, but glazed goods or very light fabrics slip very easily; this fault is obviated in Hummel's machine which folds and measures all kinds of finished goods.

There are several other systems, which we need not describe as the best results are obtained by the rectometer and the machines shown in fig. 118, page 283, and fig. 119, page 284.

VARIOUS SYSTEMS OF PRESSES:

HAND, POWER, HYDRAULIC, STEAM-PLATES ETC.

In all ages attempts have been made to equalize fabrics, by subjecting them to a certain pressure. The frescoes of Pompeï prove to us that the screw-press was known and employed in ancient times. (See fig. 120, page 286.)

The simplest press consists of four pillars or uprights each firmly bolted to a base-plate at one end and to a crown plate at the other, with a moveable press-plate between; this was formerly weighted by means of iron etc., afterwards this method was superseded by a screw, (passing through crown-plate) and hand-wheel. (Fig. 121, page 296.)

It was only in 1796 that Bramah of London constructed the first hydraulic press, based on

the principle of equality ot pressure already discovered more than a century before by Pascal.

Fig. 122, page 296, shows a complete hydraulic press as employed at the present day. A reservoir with pump communicates by a pipe with the cylinder under the press-plate; in screw-presses the pressure is given from above, in hy-

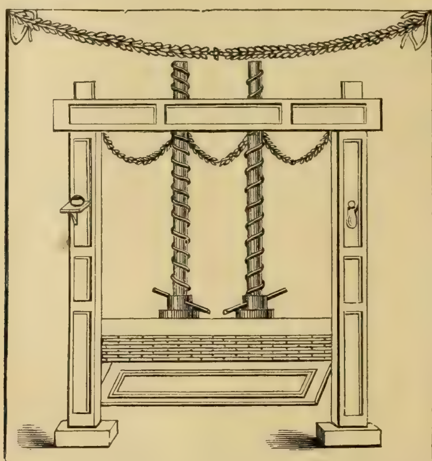


Fig. 120. An ancient press after frescoes of Pompeï.

draulic presses by the ram from below. The pumps have generally two pistons; the larger gives a rapid motion at the beginning and the smaller a slower but more powerful and final impulsion.

Fig. 123, page 286 A, represents a similar press complete and as at work the pieces are separated by plates, which may be of different

FOLDOUT

NOT

DIGITIZED

substances. Zinc plates cost less and take up less room but they soon get bent and out of shape, wood plates are specially constructed and the wood should be dry and well seasoned. Each plate is made of two pieces of wood, glued together with casein glue; care must be taken to so place the pieces of wood that the grain is crossed to prevent warping.

The same press can be worked by hand or power. Fig. 124, page 288, shows a press of this kind; all hydraulic presses should be provided with a manometer.

In large factories the double press is used (fig. 126, page 290 A).

Two presses are placed side by side, whilst one is being filled, the other is emptied; in this case it is preferable to work the pumps by power. An oven for heating iron plates is shown; these plates are more particularly used for the special finishing of woollen and half-woollen goods (cotton warps) but they are seldom used for cotton goods.

Instead of employing loose plates, not forming an integral part of the machine, another system has been invented which is very advantageous for styles which require hot-pressing. It consists of hollow chests or plates arranged to work inside the columns and between the press and crown plates. The steam plates are all connected together by elbow jointed pipes through which the steam, heating the plates, circulates, fig. 125,

pages 289); the goods protected by sheets of thin cardboard, are placed on the plates, and

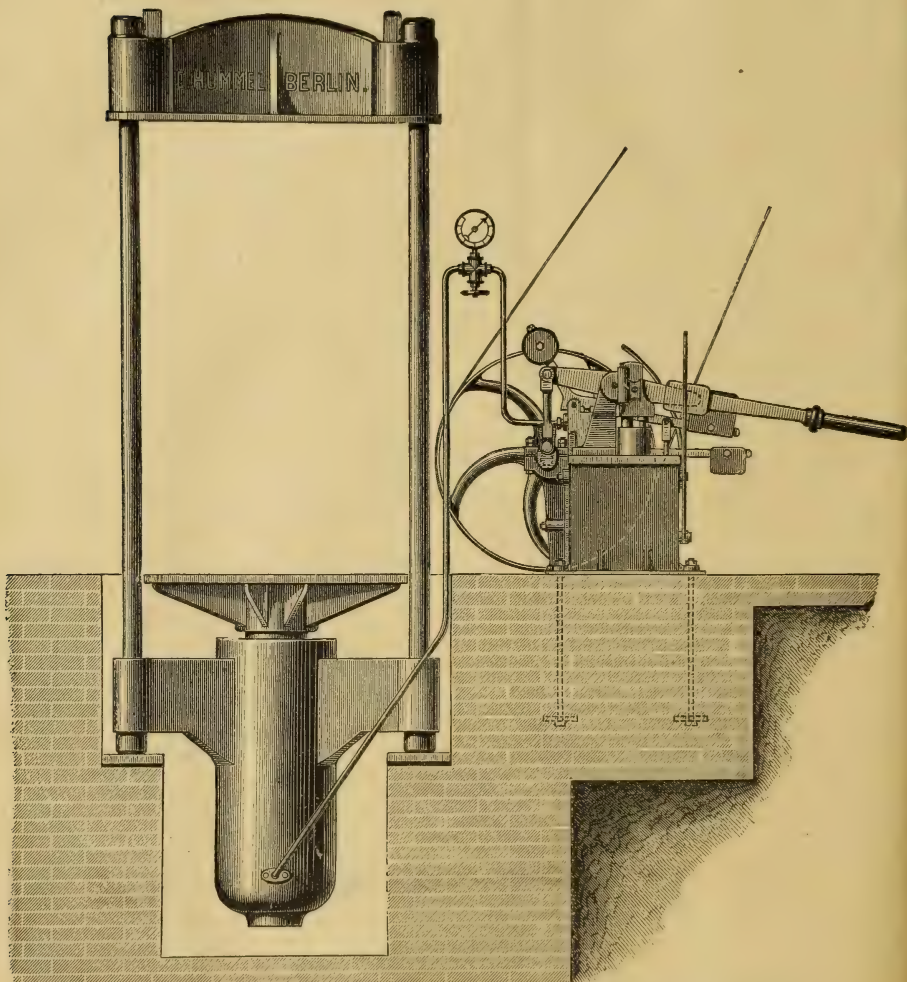


Fig. 124. Hydraulic press with pump to work by hand or power.

subjected to the action of the press. — After they have been pressed, fresh cold water is circulated

through the plates and the action of the press is the more effective in proportion to the degree of heat and rapidity of cooling. A considerable

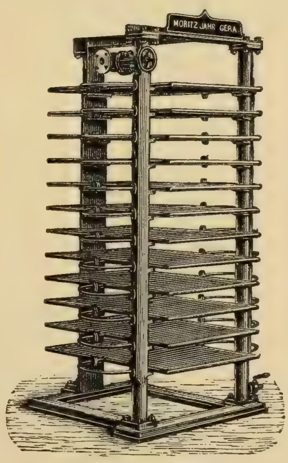


Fig. 125. Press with plates heated by steam (steam pipes not shewn).

pressure can be obtained from the hydraulic press; the following table gives the normal pressure of ordinary presses, with the dimensions of plates and distances between them.

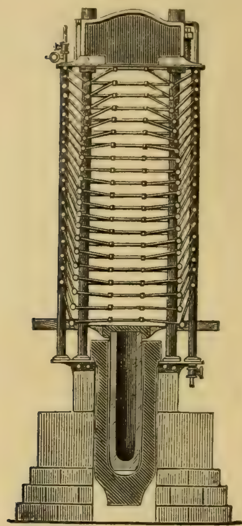
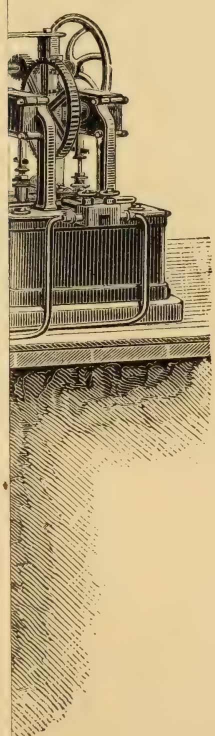


Fig. 127. Hydraulic press with steam plates and pipe connections.

Nos	DIMENSIONS of PLATE		DISTANCE between THE PLATES	FORCE in KILOS
	length	width		
	millim.	millim.	metre	kilos
1	600	500	1 . —	30.000
2	700	500	1 . 10	50.000
3	700	500	1 . 20	75.000
4	800	600	1 . 30	100 000
5	800	600	1 . 30	175.000
6	900	700	1 . 40	200.000
7	900	700	1 . 40	250.000
8	1000	800	1 . 50	300.000
9	1200	900	1 . 60	350.000
10	1200	900	1 . 80	400.000

NB. 1 metre = 1000 $^{m}/_{m}$ = 39$^{3}/_{8}$".
1000 Kilos = 1 Ton.



FOLDOUT

NOT

DIGITIZED

MAKING-UP, TICKETING, STAMPING AND PATTERN-CUTTING.

The finished goods, after pressing, doubling, folding, rolling up etc. should be neatly fastened at each end, either by tapes or the selvages tied with string — In some works this making-up is done before pressing; in most cases it is advisable to tie the pieces provisionally before pressing with slips knots which are drawn tight and fastened before the goods are taken out of the press.

The small apparatus fig. 128, pag. 292, is used to facilitate hand fastening; the selvage end of the piece to be made up is placed under the notched frame which is securely held by means of pedal below (not shown). The notches indicate exactly where the ends are to be tied and the work is thus more regularly performed. By means of a spring underneath the table the notched frame is released, the piece taken out and replaced by the next.

Printed goods, folded in the ordinary manner are usually made up with one or two fastenings at either end. — When pieces are small and the design has a large repeat, they are tied only once at each end. The next operation is to affix

the ticket, often elaborately got up with the name of the firm, trade mark, class and quality of goods, length, width, price etc. of piece. As an adhesive ticket can easily be removed it is usual to insert a ticket or vignette with length etc. inside the piece and to stamp the goods with a special, or trade, mark at the beginning and end of the piece.

The endings of white goods are often inter-

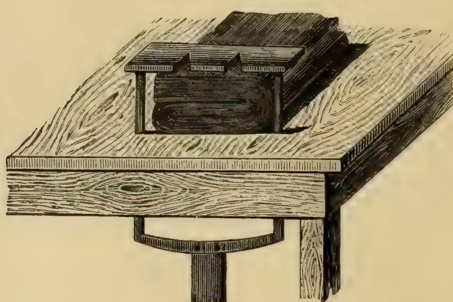


Fig. 128. Binding frame.

woven with variegated threads of silk, cotton, gold, or silver, sometimes even richly embroidered by hand or machine; occasionally these endings (chefs) (1) are printed with gold or silver leaves.

(1) *Chef de pièce* is a special mark so called in France for the endings of white and finished goods; it is legal property and equivalent to a registered trade-mark and a piece is only considered complete with such marks. In grey-cloth this ending or mark is interwoven in colored weft (one thread) at one end, and with variegated colors (weft threads) at the other or principal end.

A small hand press fig. 129, page 294, is used for this purpose; the engraved stamp is heated by gas, or a hot iron, the fabric, slightly damped, is sprinkled over with albumen powder, the gold leaf then placed on it, and the press screwed down; the heat causes the albumen to coagulate, and adhere to the parts stamped, and thus fix the gold leaf. The excess of albumen is removed with a badger hair brush.

The endings may also be stamped with gold or bronze powder mixed with gum, a damp sponge being passed over it and the powder fixed by heat.

With regard to the different modes of folding and making up it is very difficult to specify them as they are numerous and varied. Manufacturers and pattern-card makers are constantly taxing their ingenuity to find a more attractive or practical form; thus goods are sometimes made up in portfolio and book form with and without covering, wrong side or right side out, lengthwise or otherwise, single, double etc.

It is superfluous to enlarge further on this subject as the making up of goods depends so much upon fashion and again for export the requirements of the various markets must be considered. Handkerchiefs (silk finish) for instance are made up in a still greater variety of forms. They are sometimes folded square with border or diagonally with right or wrong side out in

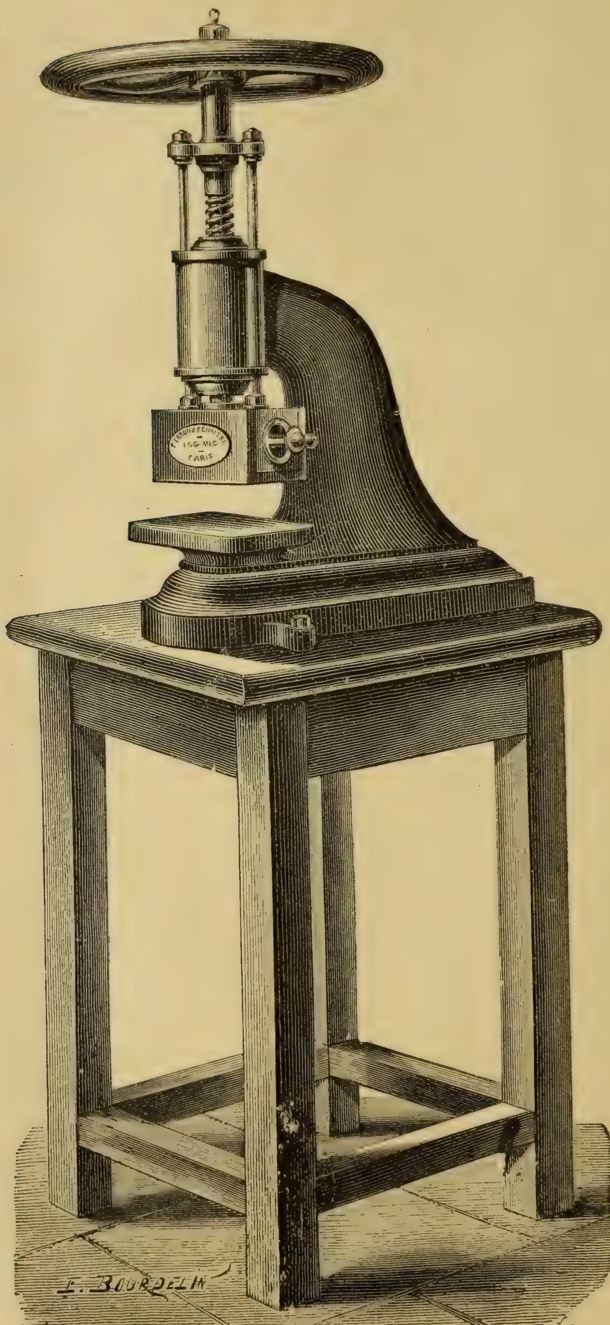


Fig. 129. Stamping press.

packets of 3, 6, 9 or 12 handkerchiefs or in 5s or 10s now that the decimal system is so much in vogue. All the mechanical and other operations which we have so far described refer to the various stages of the finishing of the goods in order to make them into a merchantable article.

Now the »rôle« of the finisher ceases and that of the merchant begins.

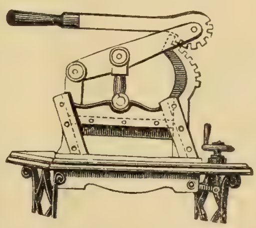


Fig. 130. Sample cutting machine.

In concluding this chapter we would indicate a little apparatus now almost indispensable in finishing establishments. We refer to the Sample cutting machine fig. 130, which is admirably adapted for this purpose.

The old method consisted in cutting the samples or patterns placed under a press by hand with a knife and little work was done; the patterns at the top were seldom uniform with the bottom ones and the appearance was bad. It is necessary

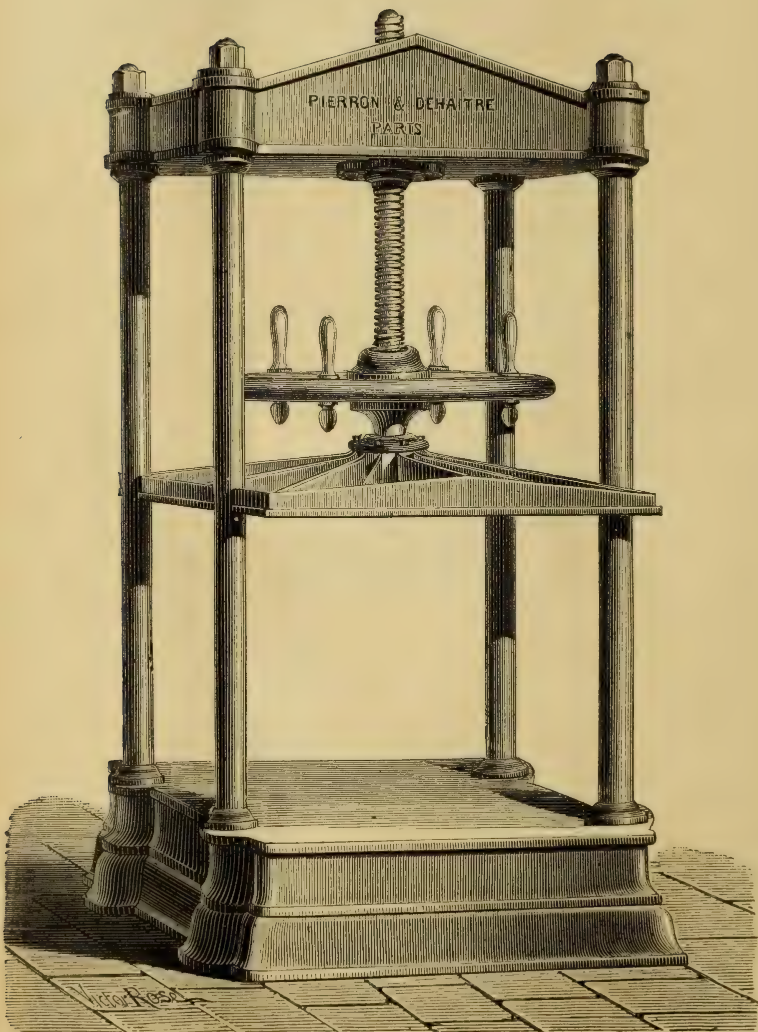


Fig. 121. Hand-screw press.

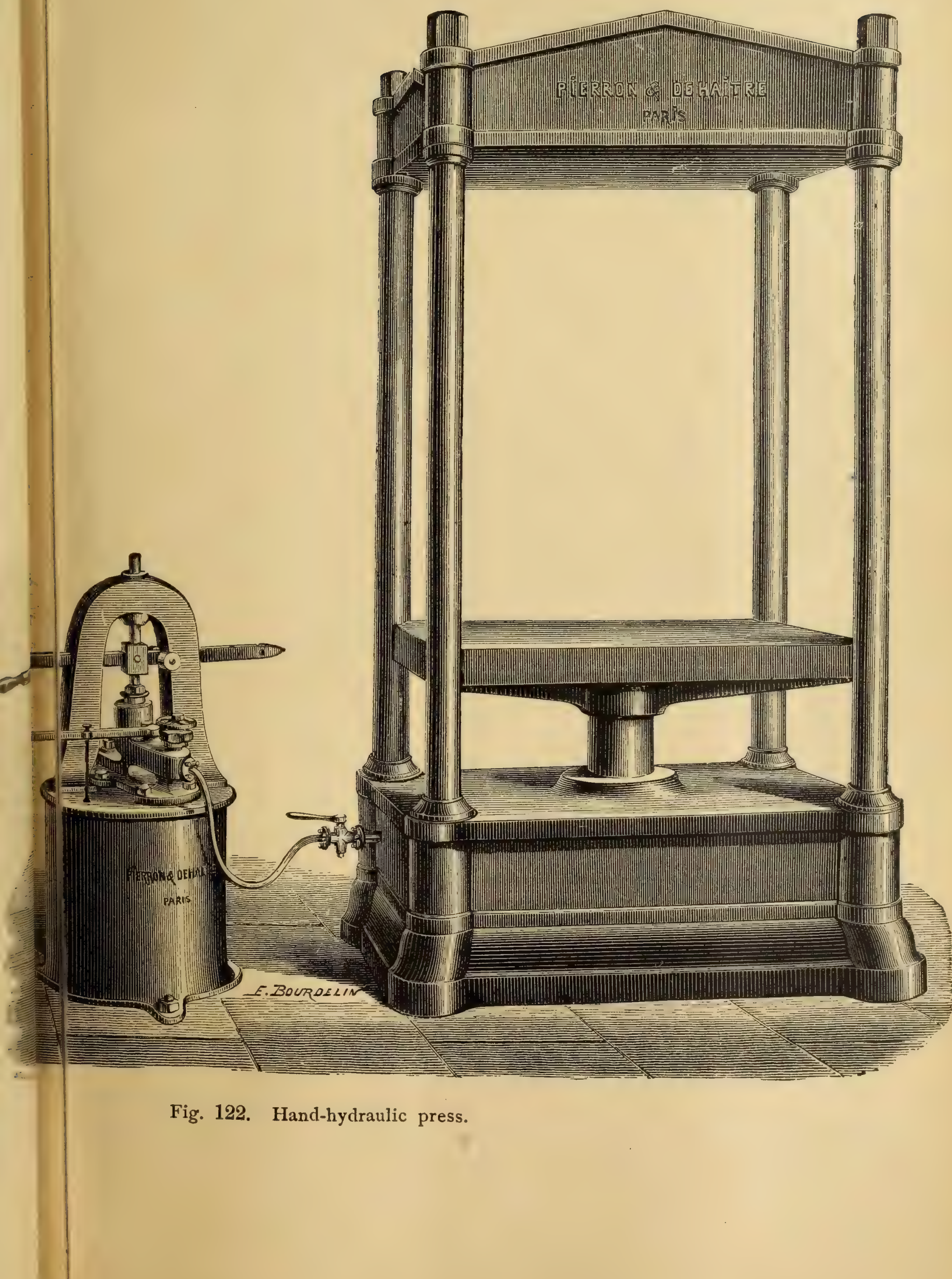


Fig. 122. Hand-hydraulic press.

nowadays to prepare large quantities at short notice and that they shall have a neat and effective appearance.

For large works these machines are driven by power and constructed to cut two sides simultaneously.

ELEMENTARY TREATISE
ON
THE FINISHING
OF WHITE, DYED
AND PRINTED COTTON FABRICS.

SECOND PART.

In the first part of this work we have treated Finishing generally, the materials used and the various machines employed.

The second part will consist of 4 chapters: the first will be devoted exclusively to chloring and blueing; the second to a general examination of the various methods of finishing all styles of white dyed or printed cotton fabrics; the third to Mildew, Discolourations, Stains, etc; the fourth to an analysis of the methods for testing all kinds of finished goods.

NB. A friendly critic made the observation on reviewing the French work that the chapter on Mildew, Stains etc. was superfluous but we do not agree with this opinion; on the contrary we think such a chapter is of moment in a treatise of this kind on the finishing of cotton goods. It is essential that finishers should know that very grave accidents and damaged goods can be caused through fungoid growths etc. even in their department.

CHAPTER IV.

CHLORNG AND BLUEING.

Chloring. When the white of a piece is imperfect, a final operation must be undertaken to restore it: for this purpose hypochlorite of sodium alone or chloride of soda or potash are used or one of these chlorides mixed with ultramarine; this operation is called chloring.

When goods are bleached and finished for »whites« they are not susceptible of receiving the chloring process; nevertheless in some works, in certain cases an indirect chloring is given by mixing a little chloride of sodium with the finishing materials. This substance has here a double action, it bleaches the cloth and favors the conversion of the starch into dextrine, but this operation must be practised with the greatest caution and on no account with old thickening materials.

The first attempt at chloring garancine styles dates from 1804, it was Widmer of Jouy who tried it first, but he was obliged to give it up, because it necessitated his personal supervision, and the accidents caused by the inattention of the workmen rendered the method too expensive and uncertain.

The goods were passed full width throgh a dunging beck containing a chloring-bath; later

attempts were made to chlorine in a vat as in a dyeing vat.

About 1846 chloring on the drying machine was invented simultaneously by three Alsatian manufacturers (*Blech*, *Steinbach de Mulhouse*, *Schwarz-Huguenin of Morschviller and Daniel Eck of Cernay*).

The goods for chloring pass through a padding mangle and are impregnated with a chlorine solution proceeding thence to a drying machine where they are dried and bleached. At that period all manufacturers had not steam drying machines, and thus printing machines were also tried for chloring, by using the chlorine in place of color and printing with it upon the cloth, which then passed to the drying arrangement; but this method has little advantage, is very dear, produces little and is uncertain on account of the inequality of the heating; it is further, only employed in works where there is a special provision for this kind of chloring.

In chloring on the drying machine, it is preferable to use a pin-engraved roller for padding, as this impregnates the goods better; by experience we find that the portions not printed become more moist than the colored parts, thus the chlorine acts more efficaciously on the whites. There is also another method of chloring called steam chloring, which dates from about 1855 and is of English origin. It is generally the first chloring given and chloring on the drying machine is

the last, blueing may be performed simultaneously with this latter process.

The operation consists in impregnating the cloth with a solution of chlorine of from $^1/_{20}{}^\circ$ to $1^1/_2{}^\circ$ Bé. the fabric afterwards passing through a steam-chamber, the moist heat determines the oxidising action of the chlorine and the destruc-

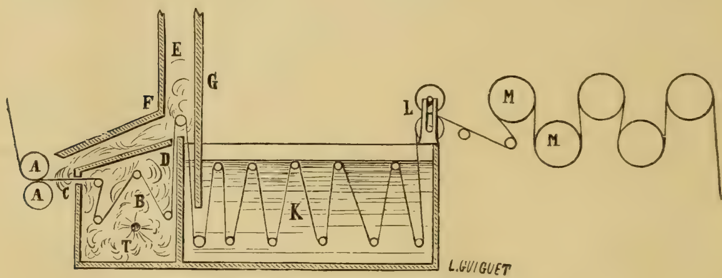


Fig. 131. Steam chloring.

AA, the two rollers by which the cloth passes after being impregnated with chlorine. T. steam-pipe in chest B. FG, sides of chimney for escaped steam from chest D, steam passing out at C. E. chimney. K. washing-beck whence piece passes by L to be well squeezed and afterwards dried on drums MM.

tion of the coloring-matter adhering to the white parts.

The strength of the bath should be so regulated that the fabric may not be injured and that the colors only suffer in an extremely slight degree, not to say not at all.

Chloring in the drying machine is done in various ways either by only passing the cloth between two rollers, the bottom roller dipping in

the chloring bath (fig. 132, page 303) or by passing the cloth through the open bath (fig. 133,

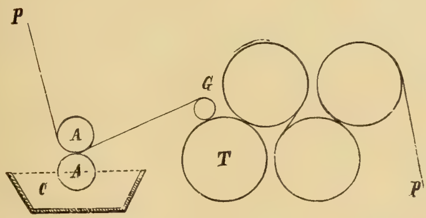


Fig. 132. Chloring between 2 pad rollers.

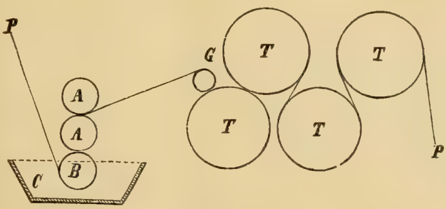


Fig. 133. Chloring open bath, 2 nips.

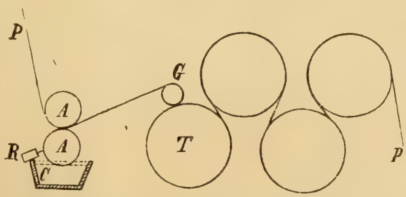


Fig. 134. Chloring with engraved roller.

page 303); in this case it is evident that a much weaker bath must be used or else furnishing the

bottom roller, this being engraved, with »doctor« which removes the superfluous liquor. Under these conditions a much stronger chloring solution is used.

As to what strength of solution to use, it would be too difficult to specify even approximately, this depending so much upon circumstances and conditions affecting the white parts.

Blueing. Before the goods are starched they must undergo a process to which too little importance is generally attached, although the fine appearance of the goods depends almost always upon it. This process is called blueing. Too much attention cannot be devoted to it and what we assert will be readily corroborated by an examination and comparison of two lots of a similar class of goods from different firms. Each piece examined minutely by itself will appear sufficiently white but as soon as a comparison is made between the goods of a skilful finisher and those of a careless one, it will be observed that the white parts in the goods of the former will be bright and pretty nearly always of the same strength or tone, whilst those of the latter will present all varieties of white except a pure one, and the goods will thus be spoiled in finishing by having imperfect »whites«. It is exceedingly difficult to define exactly what, in finishing white or printed goods, constitutes a pure white.

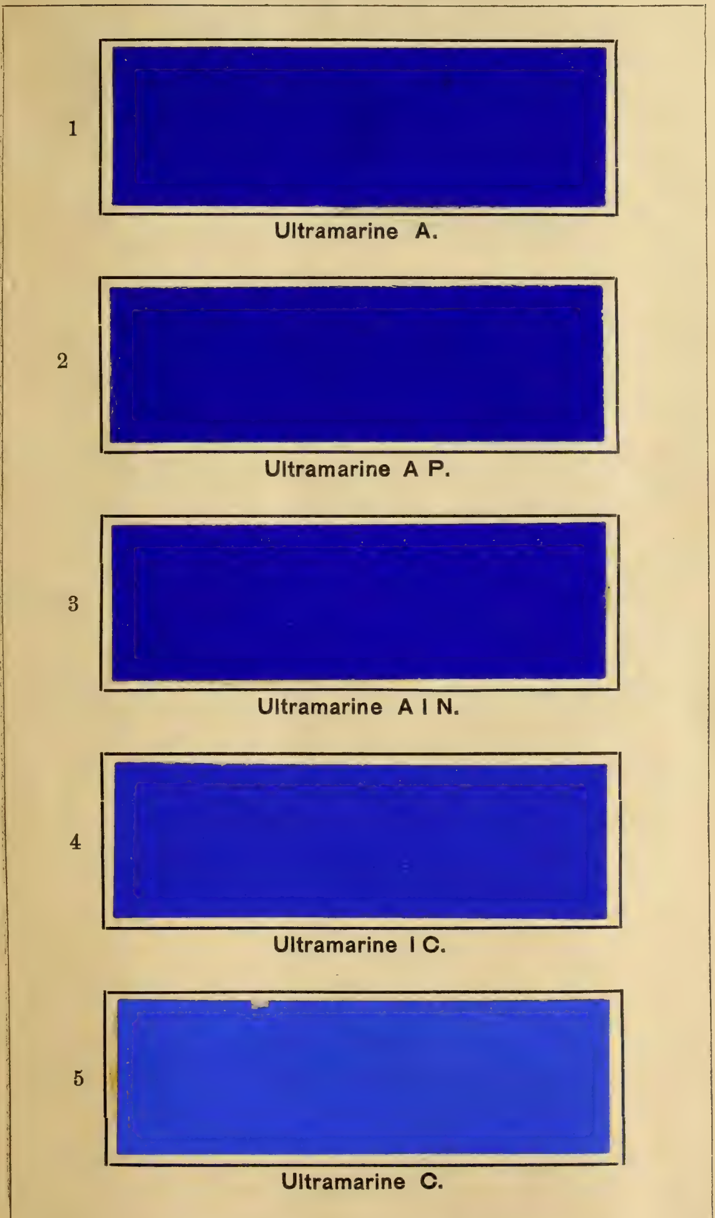
From a physical point of view white is the most complicated of all compound colors for these are themselves mixtures in varying proportions of the complementary colors. It thus follows that to obtain a pure white, a mixture or mingling in definite proportions of these so-called complementary colors, which are themselves very varied, is necessary; thus we know that we can obtain a white by mixing violet and greenish yellow, indigo and yellow, blue and orange, greenish blue and red etc.

According to the pure white desired it will be necessary to choose a special quality of blue colouring product. We say here coloring product purposely, as blueing may be accomplished by means of other colors as well as blue. This acceptation of blueing means in fact the additional operation performed on the unfinished white cloth to give it the appearance of a slightly blued white; the complementary color being already in part on the cloth we have to find what color we must mix with the azure color to produce the white; thus yellowish-tinted fabrics require a light violet blue, pink fabrics a greenish blue and with fabrics in which the white is of a greenish yellow, as for instance in the whites of discharged »bistres« (browns), blueing with violet will develop a beautiful white.

We have noticed already in the chapter on substances employed in blueing, that there are different kinds of blue in ultramarines, substances specially employed for blueing cotton tissues; not only are there ultramarine blues of pink, green or violet shades; but there are also violet and pink etc. ultramarines. We shall not return to these different substances which we think we have sufficiently dealt with in the chapter on substances intended for blueing (see p. 44). It is however important to note the effect of these different qualities; on plates VII and VIII (patterns 1 to 10), 10 different qualities or shades of ultramarine are shown on paper ranging from the yellowest to the pink shade which is now much employed by paper stainers. The first set shows an ultramarine shade applied to paper in the proportion of 200 gr. per litre. A very moderately experienced eye will distinguish the difference between these different shades; but the effect is much more apparent in the coloring of the patterns forming the second set. (Plate IX patterns 11 to 15) the first pattern is a normal white, i. e. a bleached cloth for printing purposes. This sample has by itself quite a yellowish cast which can be corroborated by comparing it with the white paper, the whiteness of which has been slightly enhanced by a weak blueing.

The other patterns are blued in the pro-

PLATE VII.


1
Ultramarine A.
2
Ultramarine A P.
3
Ultramarine A I N.
4
Ultramarine I C.
5
Ultramarine C.

portion of 1 gramme per litre of the following different qualities of ultramarine (1).

It can thus be easily seen what great influence the addition of this small quantity of ultramarine has upon the white of the cloth. To shew this effect still better we add plate X patterns 16 to 20, 5 patterns, the first of which is the natural white, the 2nd white with 0·25 grammes of ultramarine to every litre ($1^3/_4$ pints); the 3rd contains 0·50 gr. of ultramarine, the 4th 1 gramme and the 5th 1·50 gr. per litre.

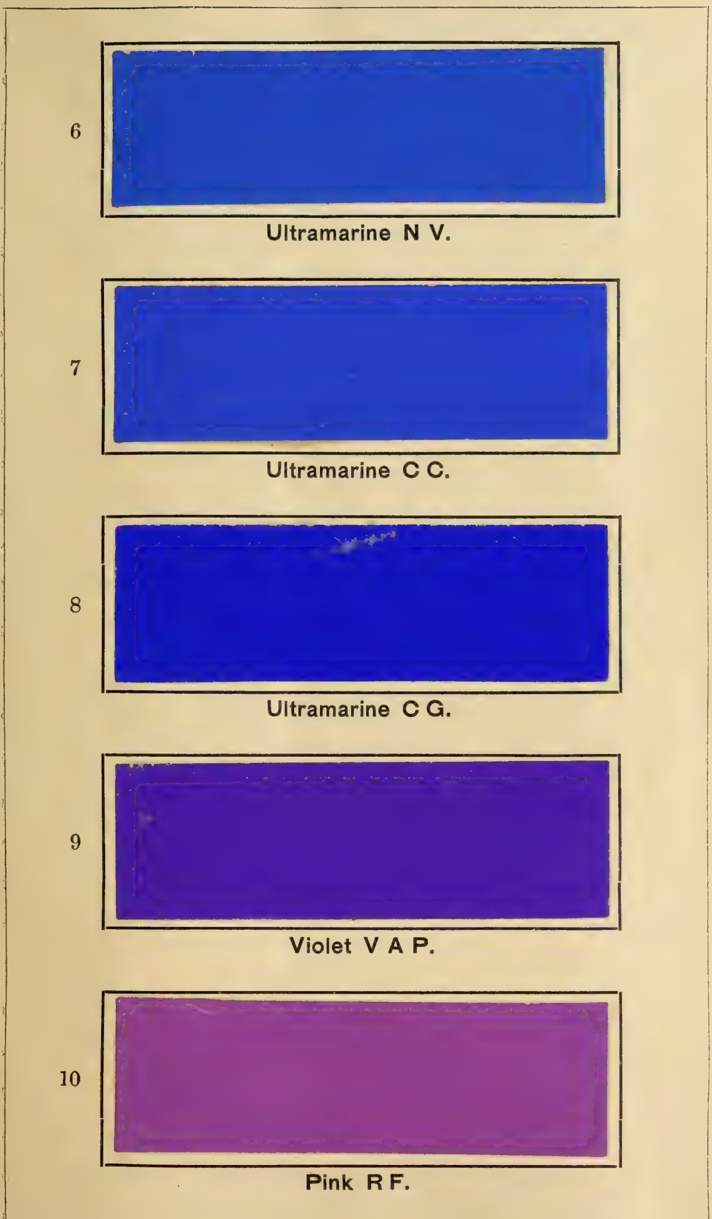
This small quantity has a considerable effect and as previously stated shows the necessity of using great care in the blueing process.

We have here dealt with the white simply without any addition of starch.

In practice it is necessary to take into account the original white of the cloth, the colors which are put on it and the thickening ingredients; to incorporate an insufficiently blued white with these would give a yellowish tinge and make the goods old-looking and faded or badly bleached; not only would the colors not come up well, where a printed fabric is concerned but the general appearance would be bad; on the contrary if a

(1) These different ultramarines (which are only a few specimens of a very elaborate manufacture) und for which we are indebted to Messieurs Deschamps Frères, show in a striking manner, the influence of the different shades as well as the numerous varieties which this house can produce in a reliable and first-class manner.

PLATE VIII.


6
Ultramarine N V.
7
Ultramarine C C.
8
Ultramarine C G.
9
Violet V A P.
10
Pink R F.

fabric be too much blued it leads to the supposition of a forced or overdone finish by establishing an artificial white, the colours become evidently less bright and the appearance of such goods is inferior. This is a fault with the Rouen goods (garancine styles) where printers have tried to remedy a defective white by exaggerated blueing.

The processes of manufacture now-a-days have enabled us to remedy these serious drawbacks (imperfect white in consequence of bleaching or dyeing or chloring); bleaching is better performed and the colors applied to the fabrics tarnish less since the introduction of alizarine than previously, when dyeing was performed by means of garancine or its derivatives. The processes of chloring are also more perfect and ensure a good white even before the blueing.

We may observe here that with white goods blueing is seldom resorted to for this purpose alone, this operation becomes then combined with finishing and performed at the same time as starching, the starching material is itself coloured with the blue and care must then be taken to note the ingredients of the thickening.

Certain substances, as China-clay for instance absorb the blue and require the ultramarine to be specially chosen precisely on account of their grey or yellow tinge. When the thickening materials consist of dextrine for example or any soluble and transparent matter the effect of the

PLATE IX.

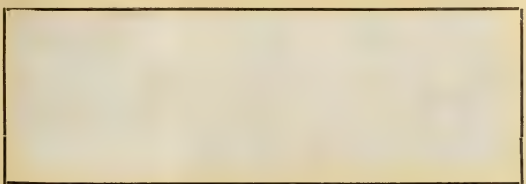
11

Printing white.

12

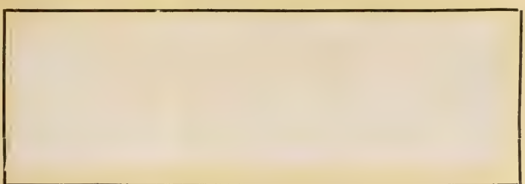
1 gramme ultramarine C O.

13



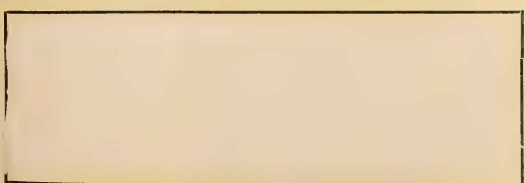
1 gramme ultramarine A I N.

14



1 gramme ultramarine violet V A P.

15



1 gramme ultramarine pink R F.

modification of color is less apparent, but here again care must be taken to see that the thickening contains nothing which may alter the ultramarine as feculas, dextrines, starches are often of an acid nature, a little alkali (ammonical or soda crystals) must be added.

It is important not to keep the blued sizing matter too long as the coloring power becomes destroyed by the souring which takes place in the ingredients.

It must also be avoided to use on two successive days, blued starch mixtures which may have been in contact with iron, as in this case an acid is formed which destroys the ultramarine: this can be remedied by making the materials alkaline.

As ultramarine is a tolerably dense substance care must be taken to stir it up well during the operations this being easily accomplished by providing the bottom of the blueing trough with a spiral rotating continually in the bath during the padding or starching operations.

As ultramarine does not mix readily with water, it is better to moisten it first with alcohol, which is done very easily and without any fear of lumps being formed.

PLATE X.

16

Normal white for printing purposes.

17

Blued in proportion of 0.25 gr. ultramarine I C.

18

Blued in proportion of 0.50 gr. ultramarine I C.

19

Blued in proportion of 1.00 gr. ultramarine I C.

20

Blued in proportion of 1.50 gr. ultramarine I C.

To obtain a good blueing the goods must be passed through very exactly at full width. The slightest fold causes inequalities which cannot be afterwards eliminated without passing the piece completely through weak acid or alum.

When desired to blue heavily, this must not be done in a single passing as this often gives pin-spots and smears; it is much better to give two or even three light passages until the desired degree of blueing be obtained.

CHAPTER V.

THE VARIOUS PROCESSES OF FINISHING.

The different processes we shall now point out as clearly as possible relate not only to those in vogue in France, but also to those of other manufacturing countries. We may observe that it is not sufficient to merely give the recipe, as frequently the best process does not give the results desired, or which ought to be obtained, if it is not well executed. All the various phases must be closely followed, and a knowledge of the result of each operation is indispensable. The majority of the processes we indicate have been tried and with good results by ourselves; we may add, not with invariable success at the first attempt. There are manifold experiments to be made, which depend on the drugs, temperature, machinery, ability of workmen etc., in one word, exerience is necessary.

We shall not classify our formulae; but simply treat them in the corresponding order to manufacturing: starching and finishing of white, dyed, and printed goods.

Comparative table of Beaumé & Twaddle.

Beaumé	$1^1/_2$	3	5	8	10	12	20	28	30	36
Twaddle	2	4	7	11	14	17	30	45	49	62

0° C = 32° F	50° C = 122° F
20° C = 68° F	70° C = 158° F
40° C = 104° F	100° C = 212° F

As there are an infinite number of different kinds of cotton fabrics, we think it will be agreeable and useful to the reader, if we give some details and explanations of their origin and manufacture, and of the etymology of their names.

Cotton (french *coton*, german *Baumwolle*, spanish *algodon*, this being derived from the arabic *gutn*) has been cultivated since times immemorial in Egypt, India and Syria.

The word »Karpus« in the book of »Esther« is probably intended to indicate cotton, inasmuch as the designations for this textile fibre in Sanscrit (Kurpasum) and modern Hindostanee (Carbosus) present a surprising resemblance.

One of the chief cotton textures is calico. (This name being derived from the city of Calicut in India). Calico is the basis or standard for all other cotton fabrics and enjoys the largest consumption. It is a plain woven material of varying widths; when woven diagonally (three, five or more shafts) it is called »twill« when the weft and the warp are of very fine and good quality it is called shirting or madapollam. Calicoes of coarse warp and weft threads (nos. 16 to 26 for the warp and nos. 18 to 30 for the weft) are called cretonnes after the french maker Creton by whom they were first manufactured.

---

1 kilo = 1000 gr:	=	2 lb. $3^1/_4$ oz.
1 lb. (English)	=	454 grams (gr.) french.
1 litre	=	$^1/_5$ English Gallon = $1^3/_4$ pints.
1 gallon	=	4·54 litres.

Besides ordinary calicoes and cretonnes there are various other makes of printers, being the same only that warp and weft are of stronger thread numbers than calico.

Madapollams from the similarly named town in the vicinity of Margulipatan in British India is also a plain fabric, but much finer than the preceding. Damask is derived from the city of Damascus, satin from Zaytoun in China, dimities from Damiette, muslin from Mosul, buckram from the city of Bokhara in Turkestan is a coarse fabric of 10 to 12 threads and is used for hat and clothes linings where the stiff form is required. A twilled cloth raised on one or both sides is called fustian, or in its various forms Swansdown, beaverteen, moleskin, beaver, kilted or piqué fustian, cord, twill, cantoon, velveteen, thickset etc. (French futaine). German barchent, English fustian from Fostat, a suburb of Cairo where it was originally produced. Cambric derives its name from Cambray in the north of France, sarcenet a light and slightly glazed fabric is named after the Saracens, mohair manufactured from goat's hair, must not be confounded with moirée a shiny fabric called after the Moors.

Nankin (yellow cotton) receives its name from Nanking in China, gauze from Gazza, baize called serge from Baies, drugget from Drogheda.

Velvet, French velours, Samit is an oriental fabric, velours is derived from the English velvet, old English velouette from Italian vellute, woolly, derived from latin vellus the fleece.

Samit whence German Sammet from εξ six and μιτον, threads, the weft consisting of 6 threads, camels hair (French camelot) was originally woven from camel hair.

In addition to these names are chiffons or shirtings, naturals, Tangeps, nansouckes etc. which refer either to a special style of weaving or particular kind of finish.

White cotton fabrics are sold now-a-days in various forms:

I. As shirtings which are again divided into 3 classes, viz: plain finish are the white goods after bleaching and for the most part very lightly calandered. Extra finish has already a certain finish which gives it somewhat the appearance of the plain shirting, but it has a better »feel« and more body. Calendered shirting, which is lightly stiffened, then hot calandered by friction to give it plenty of glaze.

2. Domestics which are divided into natural, that is the cloth is only slightly bleached and not thoroughly as necessary for the whites in printed goods, or again the cloth receives a slight blueing, or this is lightly starched, but the stiffening should not be noticeable, the fabric should have more »feel« and »weight« without the intervals between the threads being filled with foreign matter.

Afterwards come the filled or weighted finishings where considerable quantities of earthy matters are incorporated, either on one side or

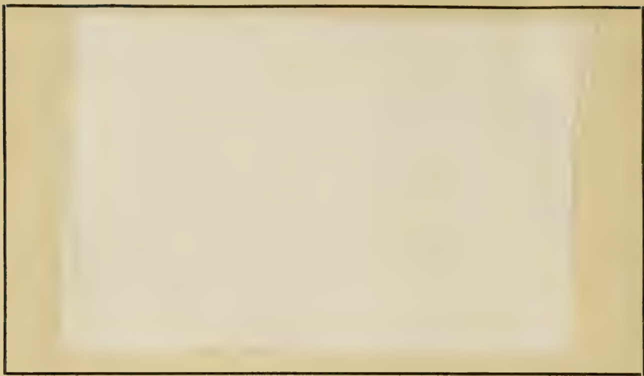
both sides of the fabric by means of the back-starching machine or the ordinary and friction starch mangles.

Finishing in this way is largely done in England but an inconvenience of this method is the dust caused in tearing the cloth, whilst the German cloths also heavily sized, but at the same time containing much fatty matter, cause little or no dust when torn.

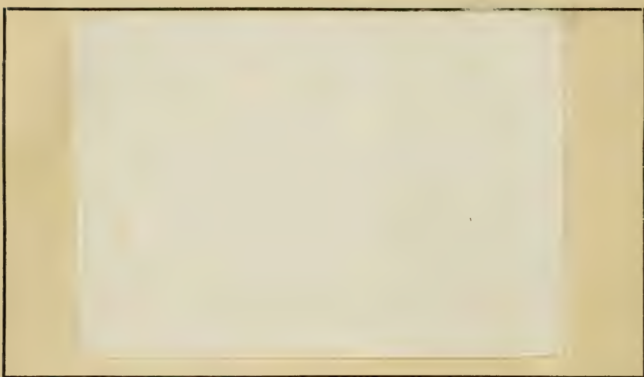
Then weighted styles of finishing. Each weighted finish may be divided intos oft weighted hard or stiff weighted, dull-weighted and glazed-weighted etc. These names are not employed commercially but they indicate the kind of manipulation performed. The names used have no connection at all with the method of procedure; and we shall also refrain from using these names which are quite incomprehensible to those uninitiated and are constantly changing according to the caprice of the buyer or the seller.

Plain dyed styles embrace the greatest variety of finishes, without reckoning the numerous kinds of cloth, such as calicoes, cretonnes, twills, cotton cambrics, sateens, brilliantines etc. finishes are now produced on all sorts of tissues, ranging from the lightest cloth to that imitating embossed paper etc. and it is even possible to give to cotton the brilliancy, suppleness and rustling frou-frou of silk.

Finishes for printed goods have undergone a complete change during the last 15 years in-



1. Calico. $^3/_4$ $^{16}/_{12}$ not starched.

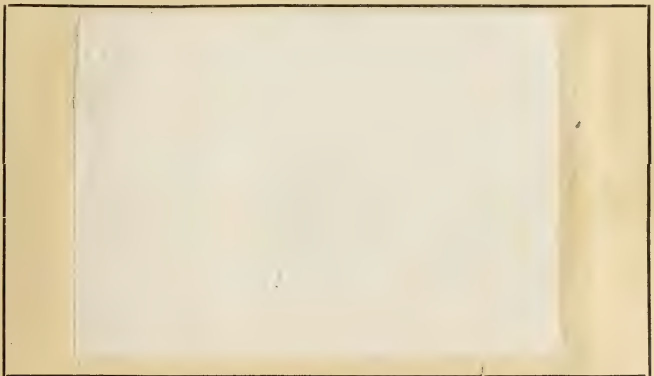


2. Calico. $^3/_4$ $^{16}/_{12}$ plain shirting finish.

stead of the simple finish with potato starch and a light glazing, dull finishes are now given with certain feel and very little lustreing etc. and in which the starching materials are simply deposited on the fabric.

As it is difficult to foretell the result of a finish when we have not the plain material before us, we have added to each variety of finish, two patterns, one showing the cloth before finishing, and the other after finishing.

3. Twill. $^3/_4$ not starched.



4. Twill. $^3/_4$ plain „fleur" finish.

1. Starch recipe for white goods, shirting style.

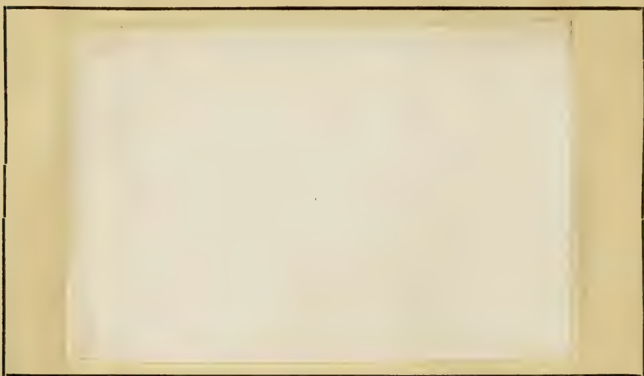
22	kilos	Potato starch
16	„	Wheat starch
15	„	China clay
15	„	Sulfate of barytes
5	„	Tallow 1st quality

Stir well up and boil in 300 litres of water, then add when mixture is lukewarm 100 to 125 gramms Ultramarine well sieved through a fine silk sieve.

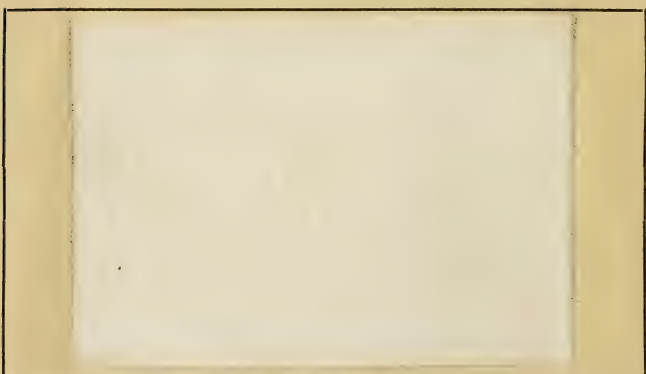
Dissolve in a beck separately:

750	gr.	White soap
1	kilo	Tallow
1	„	Cocoanut oil
500	gr.	Stearine
500	„	Soda crystals
25	litres	water.

Boil, then pour through a sieve into the lukewarm mixture, then boil well altogether. The result should be about 500 litres thickening mixture.



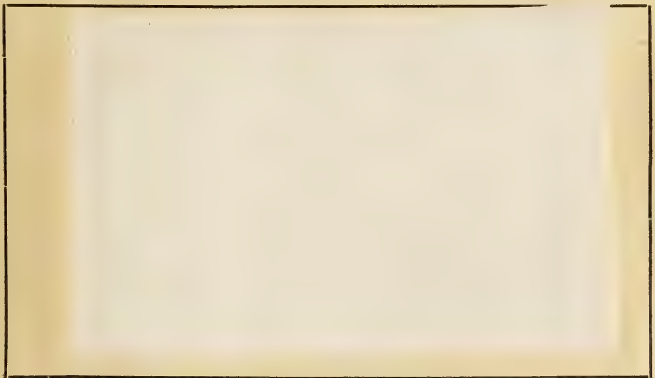
5. Cretonne. $^3/_4$ $^{18}/_{20}$. Not finished.



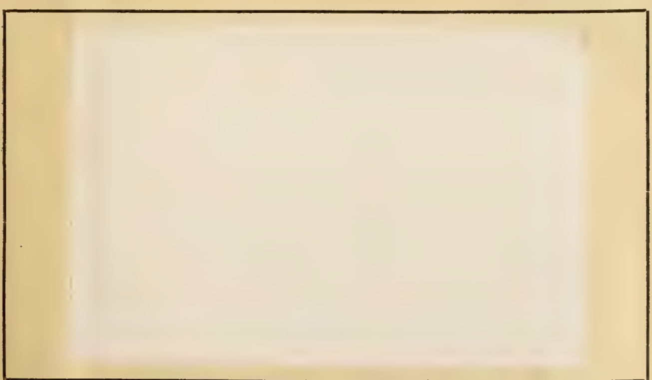
6. Cretonne. $^3/_4$ $^{18}/_{20}$. Plain finish.

The dried pieces are passed through the machine Fig. 8 or Fig. 9 Diagram Nr. 7 Plate II. Use the starch mixture warm. Avoid stoppages by all means, or „crusts“ will be formed resembling skins. The batched pieces are afterwards dried in the warm hanging chamber or on the continuous stenter.

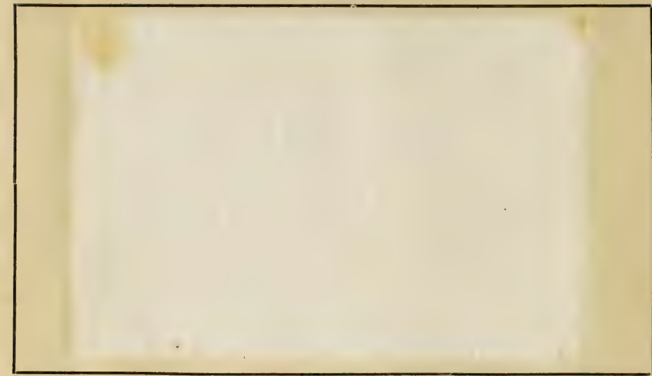
After thoroughly drying, the pieces are placed in a moist place for 12 to 15 hours, or sprinkled in such a way as to take up 800 to 900 grammes of water per 100 metres of fabric, 85 ctms. wide and weighing 8 kilos. per 100 metres in the white state. They are then calendered with a slight pressure, see patterns 2, 10, 14, 20.



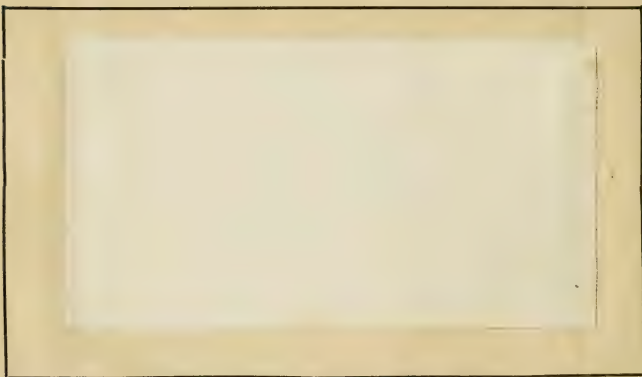
7. Calico. $^3/_4$ $^{20}/_{20}$. Not stiffened.



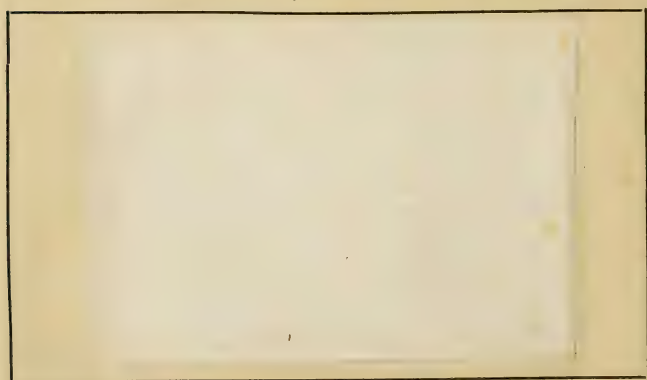
8. Calico. $^3/_4$ $^{20}/_{20}$. Plain finish.



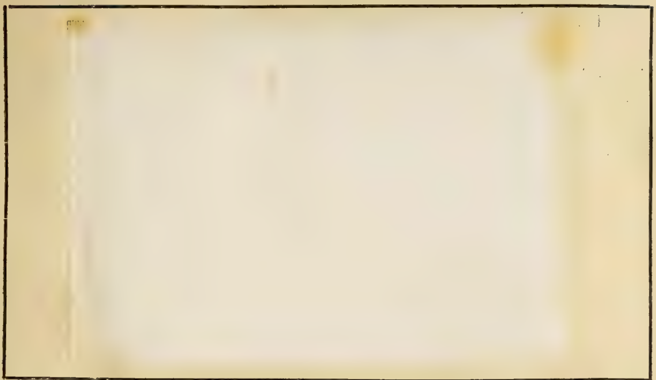
9. Calico. $^3/_4$ $^{21}/_{24}$. **Not stiffened.**



10. Calico. $^3/_4$ $^{21}/_{24}$. **Shirting.**



11. Calico. $^3/_4$ $^{21}/_{24}$. **Not stiffened.**



12. Calico. $^{3}/_{4}$ $^{21}/_{24}$. „Fleur" finish.

2. Weighted thickenings for white goods.

NB. For these styles the fabric is starched in a damp state, that is as it leaves the water mangle (see fig. 82, page 227).

We take:

1st. 10 kilos Wheat starch
20 „ Potato starch.

Boil in about 60 litres of water.

2nd. 50 kilos Pipeclay
50 „ China clay

mixed with 400 litres of water, boil to facilitate complete mixing and homogeneity and take of this paste 160 litres and add to preparation No. 1.

2 kilos Stearine
1 „ Marseilles soap
2 „ Cocoanut oil
20 litres Water.

Boil 25 minutes sieve well and pour into first preparation. Then add 200 to 300 grammes of ultramarine, well mixed with 9 litres of water, the result being about 400 litres.

For 14—16 goods use the preparation as it is; for fabrics of:

18-20	threads,	make	of	400 lit.	485 lit.	stiffening	mixture	
20-24	»	»	»	»	» 535	»	»	»
25-30	»	»	»	»	» 550	»	»	»

Pass through machine fig. 7, page 95 diagram 6, plate II. dry in continuous frame or stenter and damp well.

Calender on 3 bowls, once or twice without friction. The calendering depends on the styles, see patterns Nr. 4, 12, 22, 24, 26.

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3. Stiffening for white goods to imitate linen.

10	kilos	Potato starch
3	„	Wheat starch
10	„	China Clay
1.600	gr.	White soap
600	gr.	White wax
400	gr.	Tallow
60	gr.	Ultramarine
4	litres	Glycerine 28° B.

This should make about 120 litres of mixture. Use the preparation warm.

Starch on machine fig. 8, page 96, or fig. 9, page 98. Dry on the circular stenter, damp, allow the pieces to rest, calender through the friction calender on both sides, mangle 4 times.

See pattern 16.

---

4. Plain soft shirting.

80	litres	Water
15	kilos	Wheat starch
3	kilos	Potato starch
3	kilos	China clay

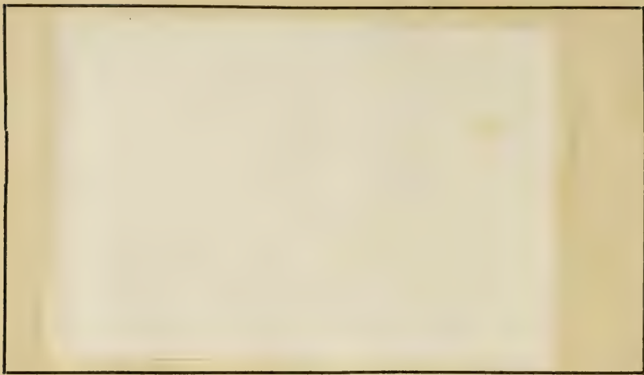
and a few grains of ultramarine according to blueing required. Boil by steam, after boiling leave the preparation 10 minutes; if too thick, dilute suitably with water and finish on machine fig. 9, page 98. Dry in the continuous stenter, damp and calender lightly.

---

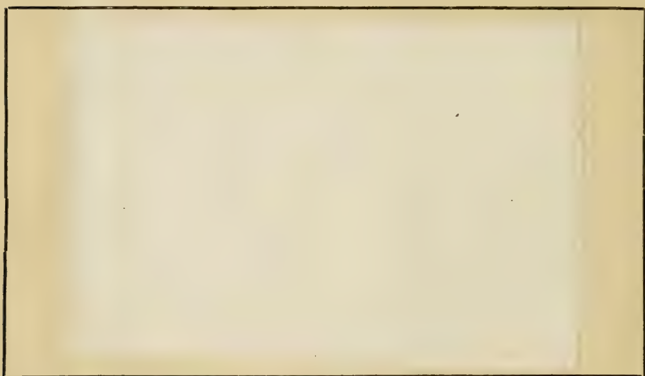
5. Thickening for white goods. German finish.

25	kilos	Wheat starch
1	kilo	Stearine
2	kilos	Palm oil
500	gr.	Soda ash.
2	kilos	Magnesium chloride
1	kilo	Sulphate of soda
1	litre	Glucose syrup

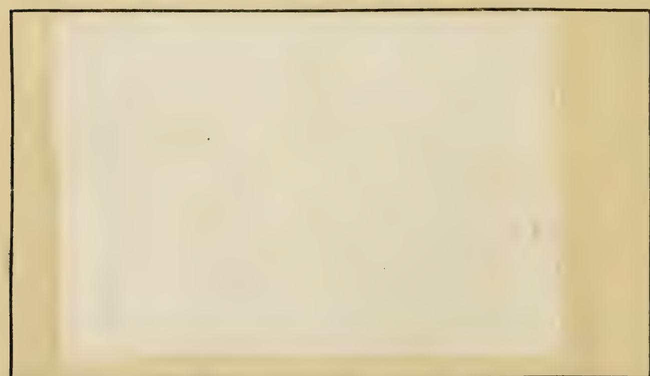
make about 150 litres thickening mixture, starch on machine fig. 9, page 98, diagrams 6 and 7.



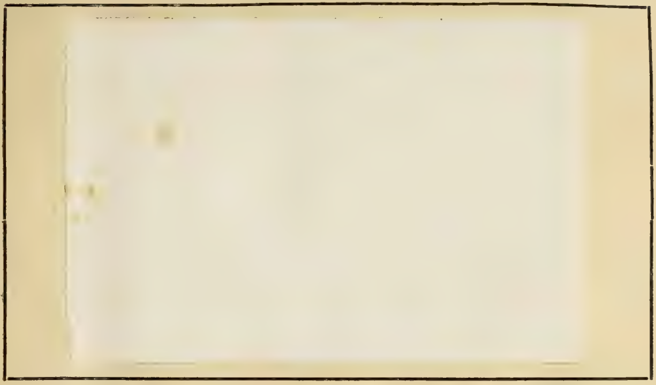
13. Cambric. $^{3}/_{4}$ $^{28}/_{32}$. Not stiffened.



14. Cambric. $^{3}/_{4}$ $^{28}/_{32}$. „Fleur“ finish.

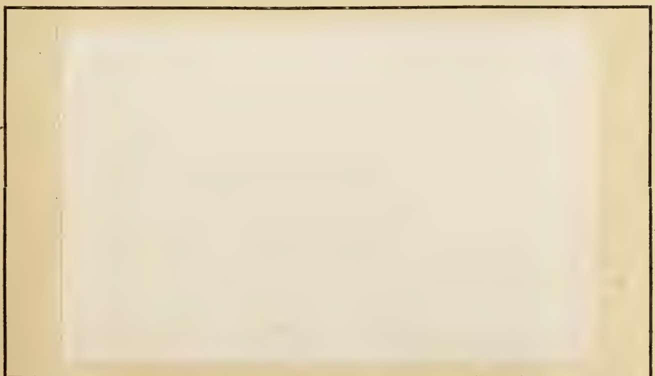


15. Calico. $^{2}/_{4}$ $^{13}/_{20}$. Not stiffened.



16. Calico. $^{3}/_{4}$ $^{18}/_{20}$. Shirting. German finish.

17. Calico. $^{3}/_{8}$ $^{21}/_{24}$. Not stiffened.



18. Calico. $^{3}/_{4}$ $^{21}/_{24}$. Soft German finish.

Plate II. Dry on cylinder drying machine, damp well and finish on chest mangle (fig. 100, p. 252).

See patterns 15, 16, 18.

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6. Thickening for white piqués.

5	litres	Preparation for 18 thread fabric (See Recipe No. 2) page 326.
1	litre	Gum Tragacanth (100 gr. per litre).
10	litres	water.

Starch on machine fig. 10, p. 100, diagr. 3, plate II. Dry on the stationary stenter, damp and roll up.

Sometimes a very light calendering is given between two small rollers covered with calico.

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7. Mixture for lustred or glazed Finish goods.

300	litres	Water
40	kilos	Wheat starch
2	kilos	Stearine.

Boil 4 to 5 hours in three cased boiler Fig. 4, p. 73, starch on machine fig. 7, p. 95, diagram 1 or 4, plate II. Dry on cylinder drying machine and afterwards wax and calender. See patterns 28, 30.

---

8. Thickening for glazed linings (Beetle finish).

15 kilos Wheat starch
1.500 gr. Tallow
400 litres Water.

Boil for a long time in apparatus fig. 4, page 73, starch on machine fig. 7, page 95, diagram 3, plate II. Dry on cylinder drying machine as in fig. 19, p. 120B, damp let remain 8—10 hours, calender cold, stretch on Heilmann's machine, then beetle several times, say 6—8 times, each time for a quarter of an hour until suitable.

9. Thickening for satinettes.

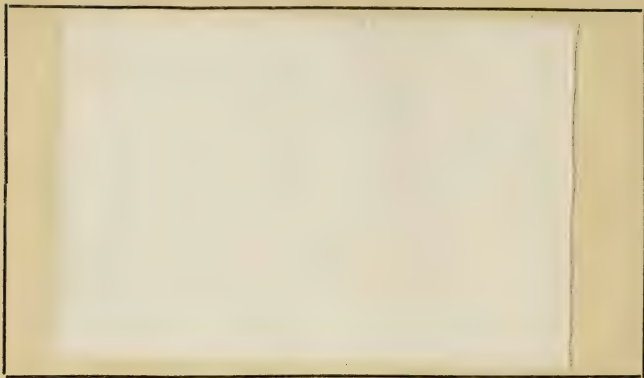
50 kilos Fine wheat starch
$1^1/_2$ kilos White wax
$1^1/_2$ kilos Tallow 1st. quality
400 litres Water.

Boil well, starch and finish on continuous stenter diagrams 15 or 17, of plate IV, damp, stretch, beetle 2, 3 or 4 times and roll up.

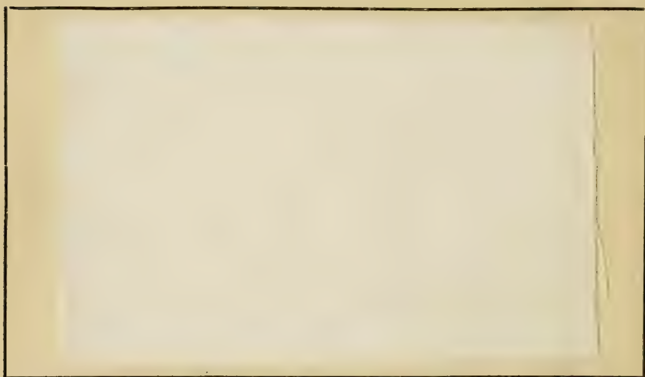
10. Thickening mixture for glazed twill linings.

30 kilos Potato starch
3 kilos Palm oil
400 litres Water.

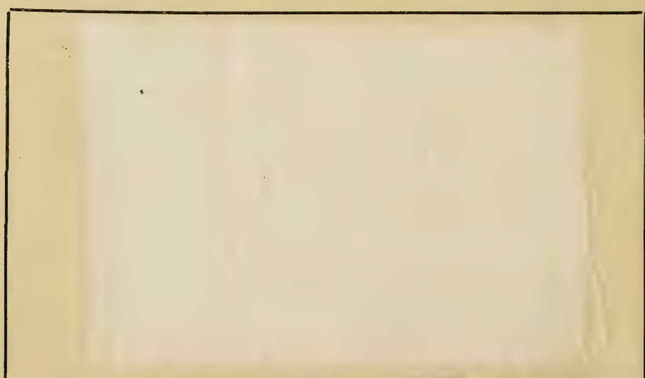
Boil for 2 hours.



19. Calico. $^{3}/_{4}$ $^{21}/_{24}$. Not stiffened.

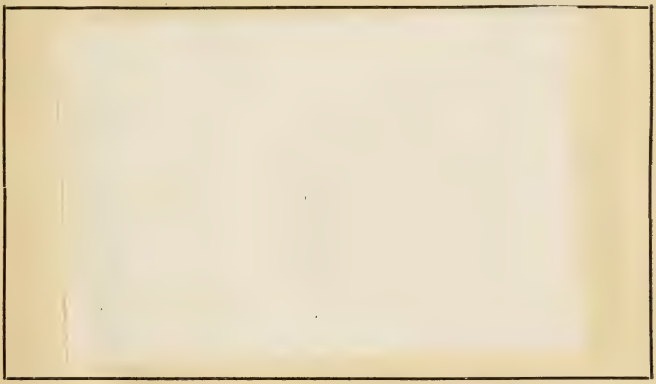


20. Domestic German finish.



21. Calico. $^{3}/_{4}$ $^{14}/_{14}$. Not stiffened.

22. Calico. $^{6}/_{4}$ $^{14}/_{14}$. Buckram finish.



23. Calico. $^{3}/_{4}$ $^{21}/_{21}$. Not stiffened.

24. Calico $^{3}/_{4}$ $^{21}/_{21}$. Nansouck finish.

Starch on machine with engraved roller. Machine fig. 10, page 100, diagram 3, plate II without doctor, top roller furnished with lapping, the right side of goods having contact with the engraved roller; dry on cylinder drying machine, damp well, calender by friction once, then wax as shewn in fig. 95, page 245 and afterwards glaze, fig. 94, page 243.

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11. Thickening for plain shirting for 60 porties (A. Schultz).

10	kilos	Potato starch
32	litres	Warm water at 40° C.
1	litre	liquid Marseilles soap (at 50 gr. p. lit.)
10	kilos	Soapstone
7.500	gr.	Alabaster
30	litres	Warm water
0.030	gr.	Ultramarine
1	kilo	Lard previously made into an emulsion in 9 litres of water.

---

12. Starch for cloth 68 and 70 porties.

60	litres	Warm water at 40° C.
12	kilos	Potato starch
5	litres	Liquid Marseilles soap at 50 gr. p. lit.
8	kilos	Alabaster
7	kilos	Soapstone
0.040	gr.	Ultramarine
3	kilos	Tallow.

The pieces passed through the starch mangle, should be dried either in the hanging room or on cylinder drying machine.

---

13. Thickening for cloth for 75 porties and cambrics.

60 litres Water
16 kilos White potato starch
3 litres Soap solution at 50 gr. per litre
60 litres Water
8 kilos Alabaster
50 gr. Ultramarine
3 kilos Tallow.

The thickening preparations Nr. 11, 12 and 13 are boiled in a vat by direct steam and at low pressure, the steam must be immediately shut off as soon as the mixture commences to thicken. Preparations containing potato starch and soap should always be prepared in clean vessels, calcareous water must not be used as it curdles or coagulates the mixture. These three mixtures do not keep well; for method of using see formulae 1, 2, 3.

14. Starch mixture for fine fabrics 80 and 90 porties, fine counts and textures (A. Schultz).

100 kilos White potato starch
120 litres Water
2 kilos Alabaster
2 kilos Tallow
0.040 gr. Ultramarine
3 litres Soap solution at 50 gr. per litre.

Starch on the reverse side on the ordinary starch mangle; dry on cylinder drying machine, damp, afterwards roll up several times, calender lightly with lapping.

15. Thickenings for glazed twill linings.

400 litres Water
30 kilos Potato starch
3 kilos Palm oil.

Boil $1^1/_2$ to 2 hours starch or stiffen on machine with engraved roller. Diagr. 3, plate II bottom roller engraved, top roller covered with calico. Right side of cloth in contact with engraved roller dry on cylinder. Drying machine, damp well, glaze on machine fig. 94, p. 249 and afterwards finish on friction calender.

16. Shirting german finish (Polleyn).

		1.	2.	3.	4.
Water	lit.	104	120	120	120
White wheat starch	kilo	2.5	4.—	1.5	1.5
Potato starch	kilo	2.5	4.—	2.5	2.5
China clay	kilo	7.5	5.—	2.5	2.5
Wheat meal	kilo	4.—	—	2.5	1.5
Mineral white	kilo	5.—	2.5	2.5	2.5
Cocoa nut oil	gr.	0.350	—	—	—
White soap	gr.	0.250	0.125	—	0.125
Soda crystals	gr.	0.125	—	—	—
Stearine	gr.	—	—	—	0.250
Rice flour	kilo	—	5.—	—	—
Tallow	kilo	—	1.500	1.500	1.5

17. Shirting German finish (Polleyn).

		1.	·2	3.
Water	lit.	150	150	240
White wheat starch	kilo	1.5	—	—
Potato starch	kilo	1.5	2.5	—
Flour	kilo	1.—	1.5	2.5
China clay	kilo	1.5	1.5	2.5
Mineral white	kilo	1.5	2.5	10.0
Gum	gr.	0.3	—	—
Sulphate of barytes	gr.	1.—	—	—
Stearine	gr.	0.075	—	—
Cocoa nut oil	gr.	0.100	0.150	0.400
White soap	gr.	0.150	0.200	0.250
Soda crystals.	gr.	0.075	0.075	0.125

For methods of using see formulae 4 and 5.

---

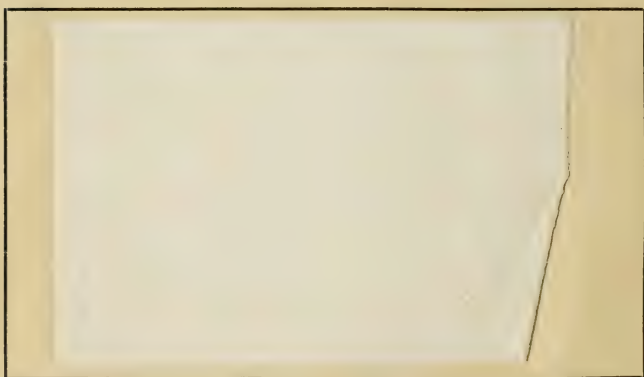
18. Thickening for white damasks.

1st. 5 kilos Acetate of lead
15 litres Water, dissolve warm and add
2.500 litres Litharge and stir well until completely dissolved

2nd. 15 litres Water
$2^1/_2$ kilos Size (best quality).

After dissolving, mix the two solutions, then add 5 kilos Wheat starch which must be incorporated gradually and the whole boiled together, stir cold and starch on mangle, fig. 8, page 96; it is indispensable to dry on the stenter or in the hot-air hanging-room, afterwards a passage through

25. Drills $^3/_4$. Not stiffened.

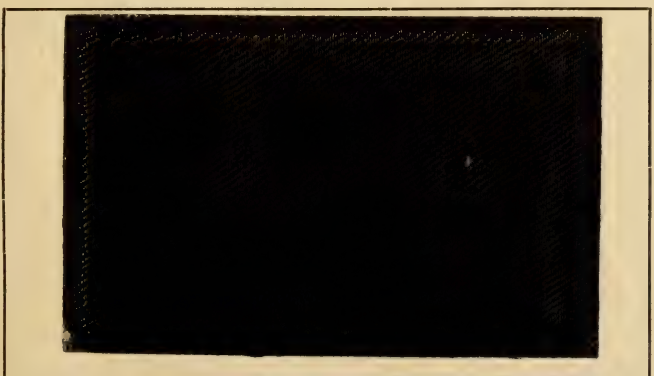


26. Drills $^3/_4$. White Finish.

27. Twill $^3/_4$. 8 ribs. Not stiffened.

28. Twill $^3/_4$. 8 ribs. Glazed.

29. Twill $^3/_4$. 9 ribs. Not stiffened.



30. Twill $^3/_4$. 9 ribs. Black glazed.

caustic potash at 4° B. and 20° C. of heat is given on the padding machine and the piece is then rolled up. The goods are then washed at full width and dried. It is however preferable to pass the pieces through a solution of potato starch from 2 to 5% containing 1% of soap and 4% of carbonate of soda, afterwards rinsing lightly and drying on the stenter; then calender and quite a special finish is thus obtained; it is difficult to discover whether the fabric has been weighted or not.

---

19. Starch for ordinary stiff sateen.

100	litres	Water
3.500	gr.	Potato starch
375	gr.	Tallow.

Boil well, starch through trough, dry in drying cylinders, damp, calender, pass through stretching machine, then beetle more or less according to fabric.

It often happens that one passage through starch mangle is not enough and that the goods require stiffening sometimes 2 and even 3 times. The last time they are starched on engraved roller machine.

Instructions for beetling.

Wind on the beetling beam of the machine a lapping from 6 to 8 metres long, afterwards

roll on the fabric to be beetled, either single or double fold. This latter method is risky as the fabric is thereby often cut. Afterwards a covering rather larger than the piece, is put over the goods.

---

20. Soft satin finish.

For sateens and satinettes it is sufficient to damp well and to calender with strong pressure without friction.

For calicoes a weak watery starch mixture is usually employed, then after drying and damping calender twice without friction. If the fabric is too bright or glazed, stiff or leathery, it is passed through the breaking machine, see pattern 64.

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21. Rustling satin finish.

To give a nice lustre from 5 to 10 grains of sulphate of soda for every litre of weak thickening mixture is added; if it is desired to give a »crackling« or »rustle«, we add, simply chloride of sodium. The remaining treatment is the same as for soft satin finish, formula 20.

Thickening for beetled linings.

22 A. Thickening for beetle finish.

8 kilo Potato starch
260 gr. Resin
260 gr. Tallow
135 gr. Marseilles soap
135 gr. Spermaceti
400 gr. Wax.

Boil for $1^1/_4$ hours and make about 100 lit. mixture.

22 B. Thickening for beetle finish.

4 kilos White wheat starch
280 gr. Wax
175 gr. Paraffin
50 gr. Spermaceti
macking about 75 litres mixture.

Beetle the pieces for from 20 to 45 minutes. See patterns 38, 54.

23. Thickening for embossing styles.

200 litres Water
35 kilos White wheat starch
4 kilos Size
10 kilos Potato starch
2 kilos Wax.

Stiffen the goods two or three times on the ordinary starch mangle dry each time on cylinder drying machine, after each drying operation, damp,

calender lightly to equalize the cloth, damp again and afterwards pass through embossing machine (see patterns No. 42, 44, 46, 48).

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24. Thickening for plain black (Stein).

18.250 kilos White wheat starch
292.000 kilos Water
29.200 kilos Alabaster.

Boil, mix and add afterwards

0.438 kilos Verdigris
14.600 kilos Logwood 20^0 B.
43.800 kilos Water
3.650 kilos Potato starch

starch according to diagram (plate II, fig. 7).

The goods must be either calendered or mangled for plain or linen finish respectively, damping according to requirements.

Colored thickenings for hat-linings etc.

The cloth used for this style of linings is exceedingly light, very open reed and pick. It is not easy to dye them and therefore a colored stiffening mixture is used which colors the fabric and fills the meshes or intervals in the cloth.

---

25 A. Blue thickenings for hat-linings.

220 litres Water
30 kilos White potato starch (farina)
2 kilos Tallow
45 to 50 gr. Ultramarine.

Sieve well to form a homogeneous mixture and boil in the autoclave apparatus (fig. 5, page 75). Again sieve after boiling. Stiffen on doctor starch mangle twice in succession, first on wrong side and then on right side of cloth, dry on stenter, calender or moiré as required.

25 B. »Solferino« thickening for hat-linings.

215 litres Water
75 kilos White potato starch (farina)
4 kilos Tallow,

then add 160 litres water in which has been previously disolved 500 to 600 gr. of fuchsine.

Starch three times on doctor starch mangle, changing side of cloth each time and commencing with the right side; goods then to be dried on the stenter and well calendered. In this way, all shades of colour may be incorporated with the starch thickenings such as aniline violet, aniline green, lakes etc.

26. Ordinary thickening for 14 rib twills.

50	litres	Water
2	kilos	Potato starch (farina)
250	gr.	Wax
250	gr.	Cocoa nut oil
100	gr.	Oleine.

27. Ordinary thickening for 13 rib twills.

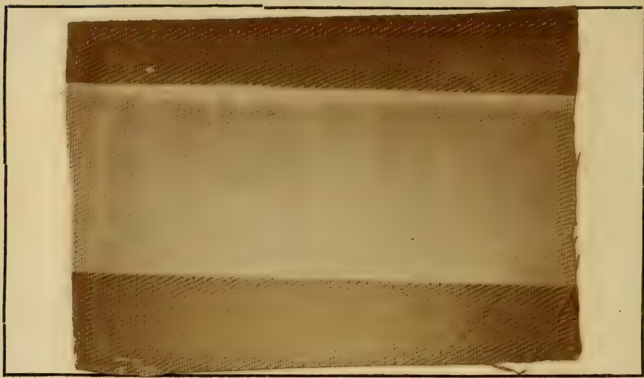
50	litres	Water
25	kilos	Potato starch (farina)
250	gr.	Wax
250	gr.	Cocoa nut oil
100	gr.	Oleine.

28. Ordinary thickening for 11 rib twills.

50	litres	Water
2·8	kilos	Potato starch (farina)
250	gr.	Wax
250	gr.	Cocoa nut oil
100	gr.	Oleine.

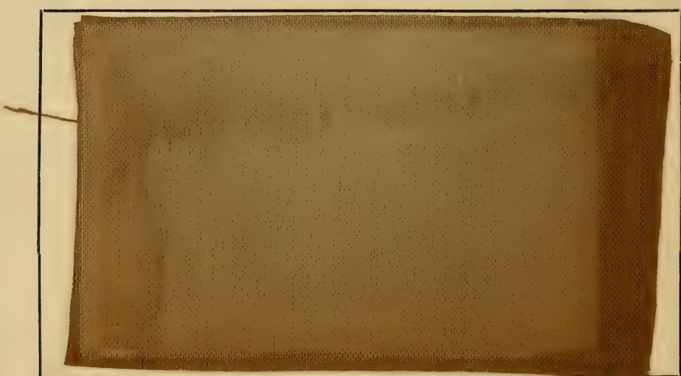
29. Ordinary thickening for 10 rib twills.

50	litres	Water
31	kilos	Potato starch (farina)
250	gr.	Wax
250	gr.	Cocoa nut oil
100	gr.	Oleine,

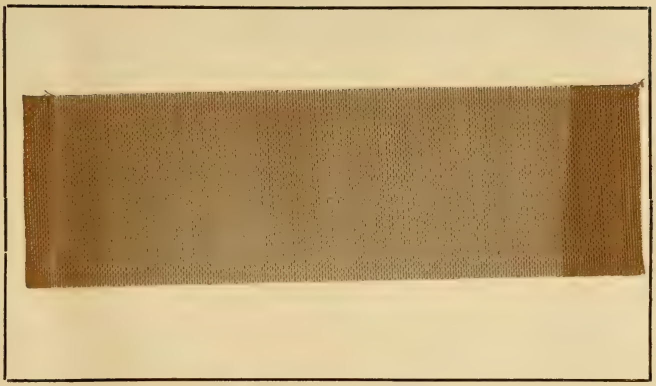


31. Chamois twill. Not stiffened.

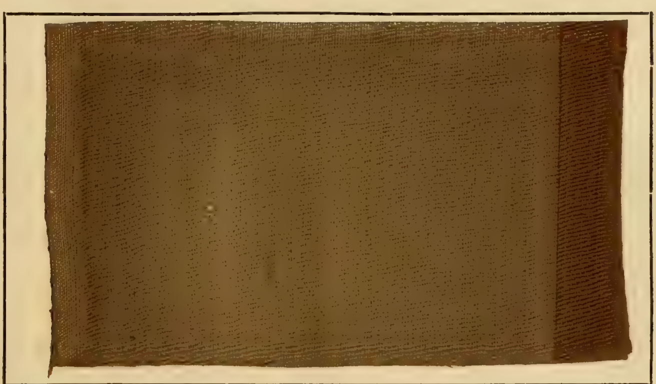
32. Chamois twill. Glazed.



33. Calico slate. Not stiffened.



34. Calico mangled.



35. Satinette. Not stiffened.

36. Satinette Chinese Satin finish.

30. Ordinary thickening for 8 rib twills.

50	litres	Water
385	kilos	Potato starch (farina)
250	gr.	Wax
250	gr.	Cocoa nut oil
100	gr.	Oleine.

31. Thickening for buckram.

50	litres	Water
5	kilos	Potato starch (farina)
10	kilos	China clay
500	gr.	Tallow.

For white, add a little ultramarine blue; for plain black, logwood and iron liquor as required.

32. Thickening for hat-linings »Tangibs«.

100	litres	Water
30	kilos	Dextrine.

Starch twice, dry on stenter with strong vibration or Tig motion (elastic finish) so that the spaces between the threads remain unfilled.

33. Thickening for Rouen styles.

Although this class of goods does not really belong to those we are treating of, we think we ought to give some particulars about it: finishers often have to deal with this style.

These goods are washed in the ordinary bleach house washing machine, then »fulled« to thicken the cloth, which process is of course at the expense of the width and breadth; dry in the open then starch in a dextrine solution at from 8^0 to 12^0 B. according to fabric and dry on the cylindrical stenter. Add, as required to the dextrine solution, glycerine, Freppel's softening, soap etc. Avoid size, which promotes mildew and causes an offensive odour.

Dry, roll up, and afterwards slightly calender the middle bowl being either furnished with lapping or better still, with an endless blanket.

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34. Thickening for »Sateens«.

396 litres Water
4 kilos Marseilles soap.

Starch on ordinary mangle, dry on cylinder drying machine. Damp well, calender well two or three times. (See patterns 64, 68, 69.)

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35. Thickening for glazed goods (Polleyn).

420	litres	Water
4000	gr.	Potato starch
1500	gr.	Wheat starch
2500	gr.	Wheat meal
2000	gr.	Mineral white
2000	gr.	Venetian tallow

500 gr.	Stearine	Boil together and add to mixture.
250 gr.	Marseilles soap	
250 gr.	Soda crystals	
250 gr.	Cocoa nut oil	

36. Thickening satin finish for calicoes.

2 kilos	Potato starch (farina)
250 gr.	Borax
750 gr.	Sulphate of soda
3 kilos	Soap solution (see below)
40 litres	Water.

Soap solution.

$4\frac{1}{2}$ kilos	Paraffin ($3\frac{1}{2}$ kilo paraffin 1 kilo wax)
2 kilos	White soap
$2\frac{1}{2}$ kilos	Castor oil
6 litres	Water.

Boil together for 2 hours, stir constantly until cold. Boil again a little and starch when warm on mangle fig. 2, plate II as per diagram, dry on the cylinder drying machine, damp, calender, break on Heilmanns machine and beetle. It is best to beetle for half an hour then unroll goods and beetle again a second time. The cloth should be wound on, in contrary direction to the working of the beetle, but not too tightly on the beam, otherwise the fallers make undulated lines. (See pattern No. 68.)

37. Thickening for satinette.

400	litres	Water
50	kilos	Starch 1st. quality
1500	gr.	White wax
1500	gr.	Tallow 1st. quality.

Boil well, starch, dry on continuous stenter, damp, stretch, beetle 2, 3 or 4 times as required, and roll up.

38. Thickening for white grounds, calicoes and twills.

210	litres	Water
30	kilos	Potato starch
15	„	Yellow dextrine
1	„	Freppel's preparation

which can be replaced by $2^1/_2$ kilos Turkey red oil 75%.

Starch on engraved roller machine reverse side of cloth; dry on cylinder drying machine, cool, damp and leave rolled up from 5 to 6 hours; for garancine styles this is sufficient, but white ground styles are calendered more or less as required.

Twills are calendered once only, middle bowl being covered with lapping, right side of cloth having contact with lapping and reverse side with paper bowl.

The strength of thickening depends on the nature of the same, style of cloth and depth of engraving.

Goods which have to be calendered should always be stiffened more than those which are merely batched and in the latter case, they may also be stiffened with wheat or potato starch in the proportion of 2 : 1 or 1 : 1.

The thickening may be used either hot or luke warm; when it is desired to keep the mixture for a few days some soda crystals should be added to neutralize the acid which may form.

39. Thickening for ordinary shirting, weighted.

8	kilos	Wheat starch, medium quality
6	„	Potato starch (farina)
2	„	Tallow
6	„	China clay
8	litres	Water
9·8	kilos	Ultramarine.

Make 110 litres thickening mixture use warm on ordinary starch machine, dry on cylinder drying machine, damp well, calender lightly with lapping.

40. Thickening for fine cretonnes.

5 to 6	kilos	Potato starch
2 to $2^1/_2$	kilos	Dextrine
100	litres	Water
1600	litres	Glycerine 28^0 B.
$^1/_2$	litre	Calcium chloride 10^0 B.

starch on mangle diagram 2, plate II. Dry on cylinder drying machine: Fig. 11 or 12. Batch, damp slightly, let goods rest and rebatch 3 or 4 times.

41. Thickening for dull cambrics.

70	litres	Thickening mixture No. 38
500	gr.	Good Cologne size.

Treat as in No. 38, except calendering which is replaced by rolling up or rebatching 2 or 3 times.

42. Thickening for printers »Longottes«.

Thickening of medium quality. Wheat starch at 100 gr. per litre for deep pin-engraved roller.

$9^0/_0$	Ultramarine blue
$1^1/_2{}^0/_0$	of solution of wax in oil (1 lit. oil 250 gr. wax)

Starch on doctor starch mangle.

Dry on cylinder drying machine, roll up, damp and again roll up 2 or 3 times.

43. Light thickening for soft finish.

$2^1/_2$	kilos	Potato starch
750	gr.	Borax
8	litres	Lukewarm water, then
50	litres	Boiling water, and a few minutes later
2	litres	Water, well mixed and add in proportion 1 : 1.

Starch cold through ordinary mangle dry on stenter and roll up.

44. Thickening for Twills, Piqués, Damasks and Brilliantes (English method).

300	lit.	Water
20	kilos	Potato starch
20	lit.	Glycerine.

1st Starch on ordinary mangle.

2nd Dry carefully on stenter or cylinder drying machine.

3rd Calender well.

4th Pad again in following solution: 120 litres water, 1 litre gum water at 500 grams per litre.

5th Dry direct on well-heated stenter with the reverse side of cloth against the cylinders. This last operation gives the »relief« by drying to these already starched goods, and re-damping enhances the »relief« of the fabric.

45. Thickening for Calicoes.

50 litres	Water
10 kilos	Medium wheat starch
2 kilos	Potato starch
125 gr.	Stearine.

Make about 60 lit. mixture, starch on ordinary mangle, dry on machine, damp, roll up, calender lightly according to style.

46. Thickening for unsoaped Calicoes.

100 litres	Preparation No. 38
800 gr.	White Marseilles soap.

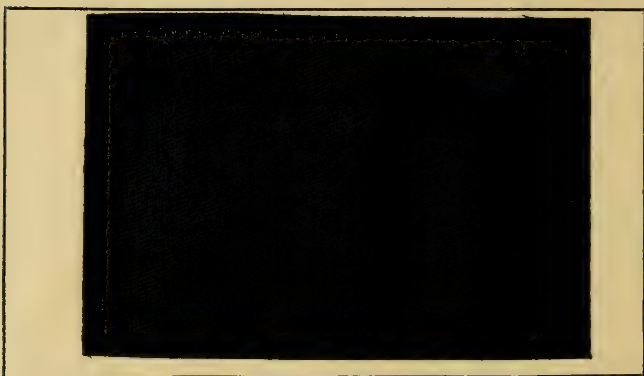
Starch on ordinary mangle, dry on cylinder drying machine, damp, roll up and calender as required.

47. Thickening for Twills.

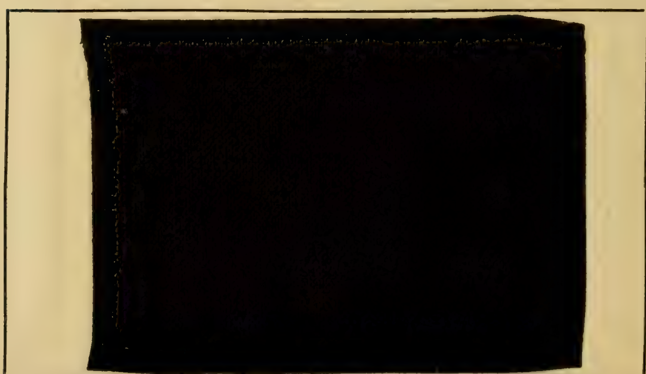
8 kilos	Wheat starch
2 kilos	Potato starch
100 litres	Water
A few grammes of ultramarine	

use lukewarm and starch the cloth on wrong side (diag. I., plate II.) with furnisher. Dry on cylinder drying machine (fig. 20) damp, calender lightly.

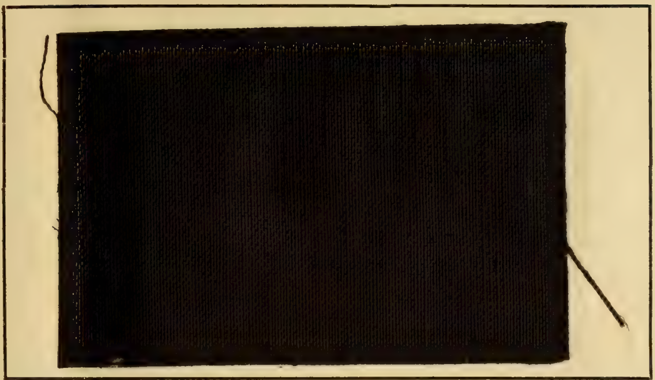
37. Satinette $^{3}/_{4}$ $^{21}/_{28}$. Not stiffened.



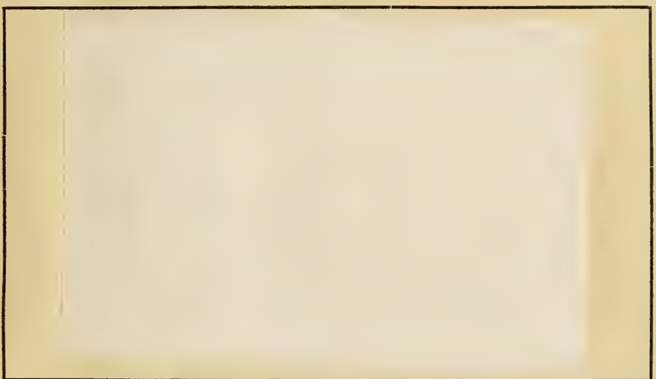
38. Satinette $^{3}/_{4}$ $^{21}/_{28}$. Satin finish beetled.



39. Cretonne $^{3}/_{4}$. Plain black. Not stiffened.



40. Cretonne $^3/_4$. Calendered and mangled finish.



41. Cambric $^3/_4$ $^{21}/_{26}$. Not stiffened.

42. Cambric $^3/_4$ $^{21}/_{26}$. Embossed finish for fans.

48. Thickening for Twills.

6 kilos Potato starch
45 lit. Water.

Make 60 litres mixture. Starch on ordinary mangle with reverse side below, as above, but calender with woollen blanket.

49. Thickening for printed »piqués« and twills (G. Stein).

15.500	kilos	Potato starch
15.500	kilos	Wheat starch
10.300	kilos	China clay
0.300	kilos	Stearine
0.135	kilos	Marseilles soap
0.110	kilos	Glycerine 29° B.
0.300	kilos	Ultramarine blue
350.000	kilos	Water.

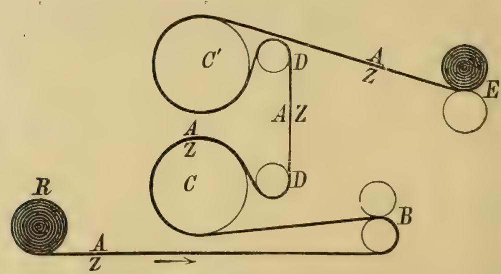
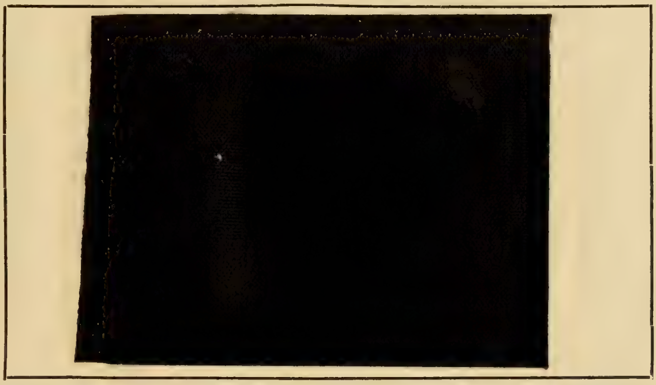


Fig. 135. Apparatus for giving »Relief« to figured fabrics.

R. Roll of cloth starched and damped. B guide rollers. C, C' 2 moveable copper cylinders heated by steam. D, D' wooden revolving rollers over which cloth passes on right side. E final batching roller. A shews right side, and Z reverse side of cloth.

43. Calico $^3/_4$ $^{20}/_{20}$ Plain black. Not stiffened.



44. Calico $^3/_4$ $^{20}/_{20}$ Watered (moiré) by engraved roller.

Boil all together in boiler, fig. 4, page 73, the boiling not to occupy too long a time, so that the mixture remains thick.

Starch on ordinary mangle on reverse side fig. 7, page 95, as shewn in diagram 2, pl. II.

Dry afterwards on cylinder drying machine fig. 21, page 122.

Damp well and dry finally on apparatus fig. 165, pag. 358.

50. Thickening for printed Brilliantes. (A. Schultz.)

Damp first, and calender afterwards, the thread is thus crushed and the thickening remains more on the reverse side and by drying, the relief is improved if care be taken to dry on reverse side only.

16	kilos	White wheat starch
2	kilos	Potato starch
150	litres	Water
0.400	kilos	Stearine soap.

Boil as little as possible at low pressure with a steam jet.

After stiffening, the goods are dried either on cylinder or fixed stenter, taking care not to stretch too much, then roll up two on three times without calendering.

51. Thickening for Calicoes.

Boil	100	litres	Water and dissolve in it
	10	kilos	Chloride of Magnesium (filter and add.) and incorporate with this mixture
	1	kilo	Hydrochloric acid
	10	kilos	White wheat starch.

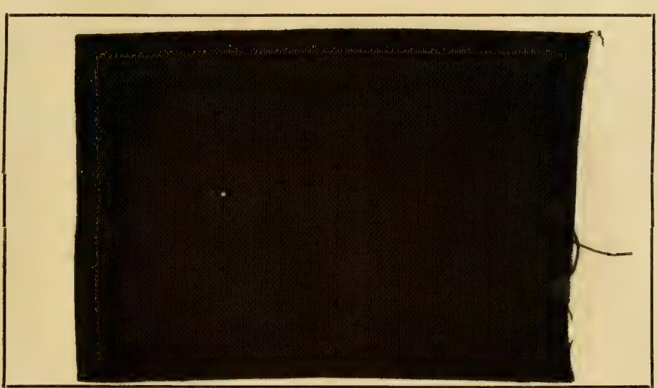
Boil all together for about 1 hour. Neutralize with lime water or ammonia.

Starch on reverse side on ordinary mangle and dry on stenter.

52. Thickening for half white ground prints.

		for $^{20}/_{22}$ threads	for $^{15}/_{18}$ threads
White wheat starch	kilos	4	5
Farina	kilos	4	4
Cocoa nut oil	grammes	400	400
Water	litres	100	100

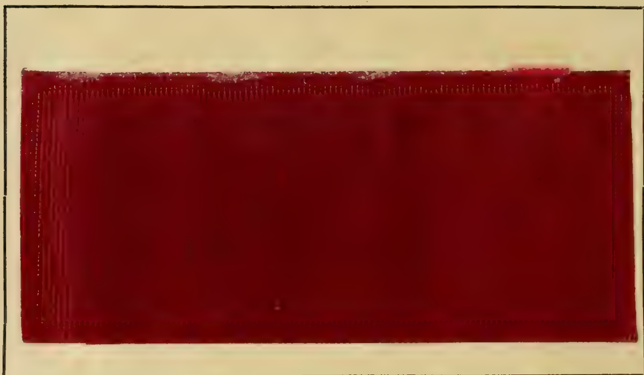
Starch on machine fig. 11, page 101, dry in the cylinder drying machine. Damp, batch and calender more or less in proportion to lustre desired.



45. Calico $^3/_4$ $^{20}/_{20}$. Plain. Not stiffened.

46. Calico $^3/_4$ $^{20}/_{20}$. Embossed for bookbindings.

47. Calico. $^{3}/_{4}$ $^{20}/_{20}$. Red not stiffened.



48. Calico $^{3}/_{4}$ $^{20}/_{20}$. Embossed for bookbindings.

53. Thickening for half white ground prints (soaped).

22.500 kilos Fine white wheat starch
22.500 kilos Potato starch (farina fecula).
300 litres Water.

May be used as it is or diluted with water in the proportion of 4 : 1, 3 : 1, 2 : 1, according to the fabric. Starch on machine pl. II, fig. 1 or 2. Dry in cylinder drying machine, fig. 22, page 123, damp, batch and lightly calender.

54. Thickening for back starching of prints (Stein).

35	kilos	Potato starch
25	kilos	Wheat starch
8	kilos	Glue (wash well before using).
8	kilos	Dextrine
300	lit.	Water.

Boil in the open pan, after boiling and cooling to 25^{0}, add 17.600 gr. chloride of magnesium at 30^{0} B. and dilute to 400 litres starch mixture; starch on reverse side with doctor, dry on cylinder drying machine with reverse side above, right side only touching cylinders, damp, batch and no calendering.

55. Thickening for prints (reverse side) (Stein).

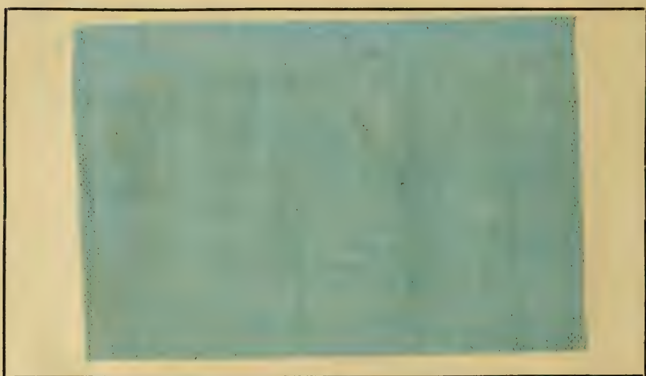
45	kilos	White starch
350	litres	Water
0.360	gr.	Ultramarine
0.360	gr.	Chloride of magnesium at 10^{0} B.

Starch and proceed as with starch mixture No. 54.

56. Thickening for dark ground prints (reverse side).

No. 1	2	kilos	Farina
	750	gr.	Powdered borax
	30	litres	Water

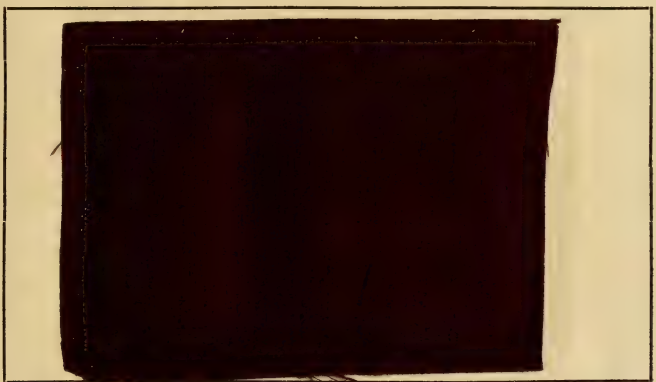
49. Calico $^{3}/_{4}$ $^{16}/_{16}$. **Not stiffened.**



50. Calico $^{3}/_{4}$ $^{16}/_{16}$. **Finished on glazing mach. (Fig. 94).**

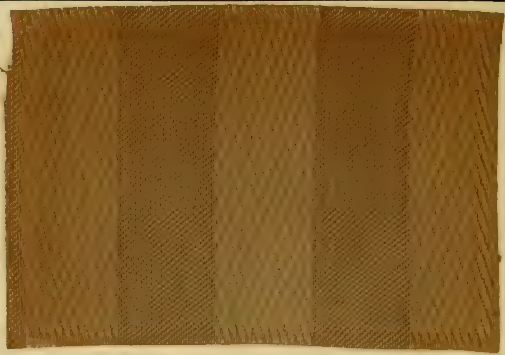
51. Calico $^{3}/_{4}$ $^{21}/_{21}$. **Not stiffened.**

52. Calico $^3/_4$ $^{21}/_{21}$. Sateen finish.

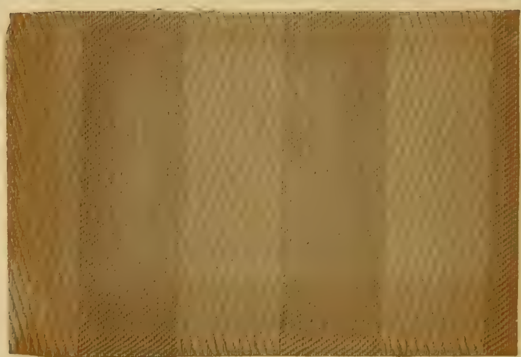


53. Satinette $^3/_4$ $^{26}/_{35}$. Not stiffened.

54. Satinette $^3/_4$ $^{26}/_{35}$. Beetled satin finish.



55. Striped Satinette $^3/_4$. Not stiffened.



56. Striped Satinette. Beetled.

No. 2	4 kilos Potato starch potato 44 litres Water $2^1/_2$ kilos Chloride of magnesium	Boil and when the mixture begins to thicken, cease boiling and add 2 litres water 100 gr. nitric acid 30° B.

Boil each mixture for 5 minutes. The whole becomes thin again, whereupon Nr. 1 is added to Nr. 2 and the operation is completed by adding 4 kilos glucose syrup. Starch on reverse side on ordinary mangle, dry on stenter, damp and batching.

---

57. Thickening for alsatian garancine styles.

210	litres	Water
18	kilos	Potato starch
18	kilos	Medium white starch
1	kilo	Freppels softening.

Starch with doctor as per diagram 3, pl. II, dry on cylinder drying machine, fig. 21, damp, batch, twice and calender with endless blanket.

58. Weighted china clay thickening for prints.

65	kilos	Potato starch
500	gr.	Malt, boil in
205	litres	Water, add
30	kilos	China clay, diluted in
100	litres	Water boil all together.

It is better to prepare the china clay a few days in advance: starch on English machine (fig. 16, page 107) after slightly damping, calender very lightly with endless blanket.

59. Thick starch mixture for back-starching with doctor.

20	kilos	White starch
10	kilos	Potato starch (fecula)
276	litres	Water
4·5	kilos	Stearine soap No. 60
250	gr.	Ultramarine.

Boil all together in boiler fig. 4, pag. 73.

60. Stearine soap.

3 kilos Stearine
1 kilo Caustic soda at 36° B.
15 lit. Water.

Boil all together for $1^1/_2$ to 2 hours, this gives a compact white mass.

61. Thin mixture for backstarching with doctor.

50 kilos Potato starch (fecule)
150 litres Water
45 gr. Oxalic Acid

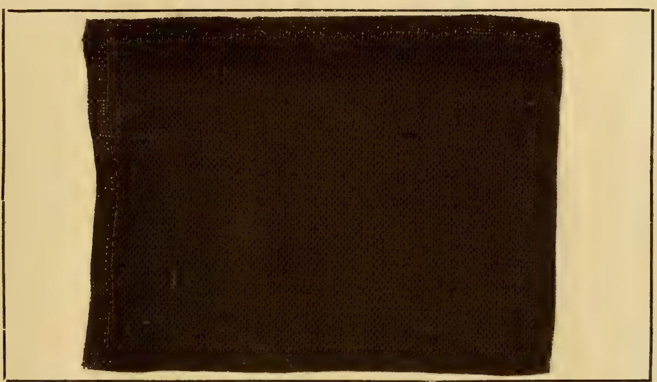
Boil 40 minutes in apparatus fig. 5, pag. 75, and make about 200 litres starch mixture.

Neutralize with a soda solution of 200 gr. per litre. Modus operandi: Damp the goods well, calender on the 3 bowl machine, right side of cloth against the metal, then starch as per diagram fig. 19, pl. IV. The starch mixture falling out of the hopper on to the reverse side of cloth is equalized by various doctors. In order to remove the glaze and to restore the crushed threads and also to blue the whites, the goods are passed through the following solution, in an ordinary mangle or padding machine before being finally stretched and finished on the stenter. viz.

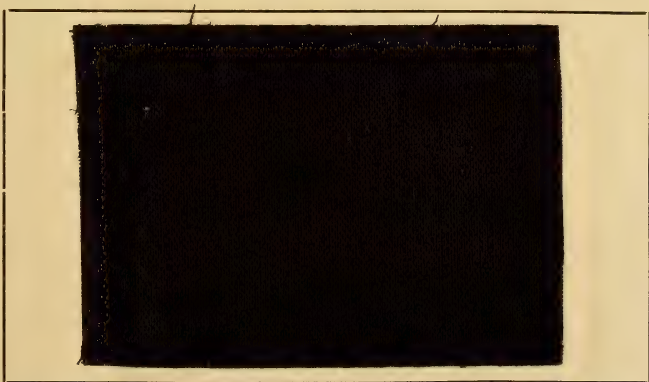
8 to 10 litres Thin mixture No. 61
22 to 20 litres Water.

and the necessary quantity of blue required for each style.

If it be desired to thicken the mixture add more stiffening and less water. To still further increase use thickening mixture Nr. 59 to which is added more or less thin starch mixture. China clay may also be added to the thick stiffening mixture, but a certain limit must not be passed, otherwise the colours will be tarnished.



57. Calico $^3/_4$ $^{16}/_{14}$. Not stiffened.



58. Cretonne $^{16}/_{14}$. Stiffened with mineral substances.

When it is desired to preserve a soft »feel«, simply blued water is used in the starch mangle, and no stiffening mixture.

After drying, damp and calender with lapping and light pressure.

---

62. Weighted thickening for shirtings and calicoes. English method.

400 lit. Water
40 gr. Starch
160 gr. China clay.

Mix well together and boil. Starch on machine fig. 8, plate II, dry in cylinder drying machine, fig. 2, plate V, right side in contact with the cans, then damp on machine fig. 67 with water containing 1% turkish red oil, batch, calender very lightly. See patterns Nos. 82 and 83.

---

63. Weighted thickening for prints. English method.

200 lit. Water
25 gr. Starch
75 gr. China clay.

Stir well together, boil and let cool.

Starch with cold mixture well sieved on machine fig. 15, pag. 106, dry on cylinder drying

machine fig. 16, pag. 107 and afterwards pass through ordinary mangle with a bath consisting of

4 to 5 kilos Quite neutral dextrine
100 litres Water
500 gr. Turkey red oil.

Dry on cylinder machine, damp after having allowed to cool well, calender with light pressure either with lapping or endless blanket.

---

64. English weighted stiffening for whites.

To make 100 litres mixture.

9—8 kilos China clay
1—2 kilos Sulphate of lime
5—7 kilos Starch made into dextrine and add 1—5% of tallow.

Dry on cylinder machine, damp and calender well.

---

65. Apparatine thickening.

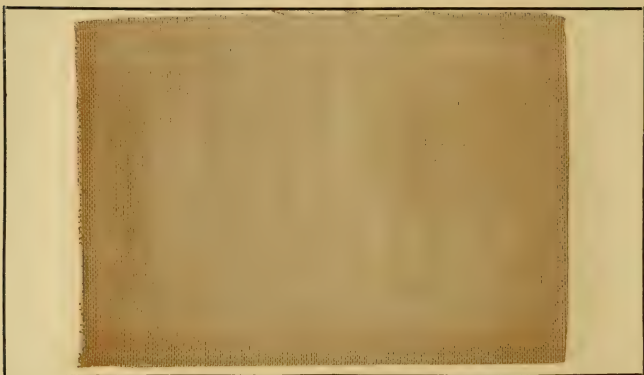
Mix well in a vessel

22·5 kilos Wheat starch
22·5 kilos Potato starch with
90 litres Cold water.

sieve through a fine sieve, then add gradually and constantly stirring.

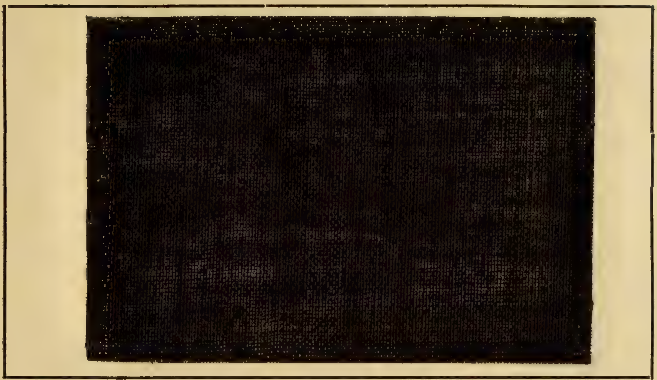
11·5 kilos Caustic soda at 36° B. mixed in
55 litres water.

59. Calico $^{3}/_{4}$ $^{20}/_{20}$. Not stiffened.



60. Calico $^{3}/_{4}$ $^{20}/_{20}$. Ordinary finish.

61. Calico $^{3}/_{4}$ $^{18}/_{16}$. Not stiffened.



62. **Calico $^3/_4$ $^{18}/_{16}$. Buckram finish.**

63. **Satinette $^3/_4$ $^{21}/_{24}$. Not stiffened.**

64. **Satinette $^3/_4$ $^{21}/_{24}$. Hat lining finish.**

Two hours at least are necessary for the complete homogeneity of the mixture to take place and for the soda to act sufficiently, afterwards the mixture to rest an hour and then add

8 kilos Sulphuric acid at 66°
25 litres Water.

Which corresponds to the acid when at 16°, rest $^1/_2$ hour, then test with litmus paper, the mixture must be quite neutral. We have given the preparation of apparatine on page 26. Under normal conditions the mixture cannot be used in the alcaline state and for that reason we give here the method of neutralising it.

According to the strength of the mixture required the necessary quantity of water is added.

The above formula serves for ordinary unweighted stiffening. If it be desired to give weight the following should be added

45 kilos China clay disolved and mixed in
60 litres Water.

This mixture weights enormously and does not powder or dust-off; if it be required softer, add for the same portion 40 litres of dextrine at the rate of 250 grammes per litre (see patterns 84 and 85).

With these data an immense variety of stiffening mixtures can be made and this preparation is certainly most simple and easy to use. The only inconvenience is that the solutions must be

stirred together by machinery because on account of their thickness manual labour is insufficient.

From the preceding data goods can be starched without weighting, or weighted and filled on reverse side; there are such a variety of styles that it is impossible to specify definitely how the formula should be applied. It is the business of the finisher to make a few experiments in order to ascertain what quantities to use.

65. Calico $^3/_4$ $^{21}/_{21}$. Not stiffened.

66. Calico $^3/_4$ $^{21}/_{21}$. Calendered Furniture finish.

At all events this method of starching is one to be highly recommended and gives results not to be obtained with any other mixture.

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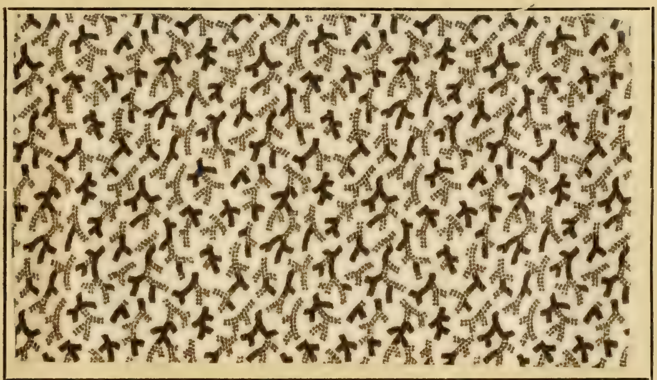
66. Weighted thickening without earthy substances (Chalimin).

16	kilos	Starch
16	kilos	Wheat starch
12	kilos	Farina (fecula)
1·50	gr.	Sulphate of zinc
0·12	gr.	Sulphate of copper
300	litres	Water
0·50	gr.	White wax.

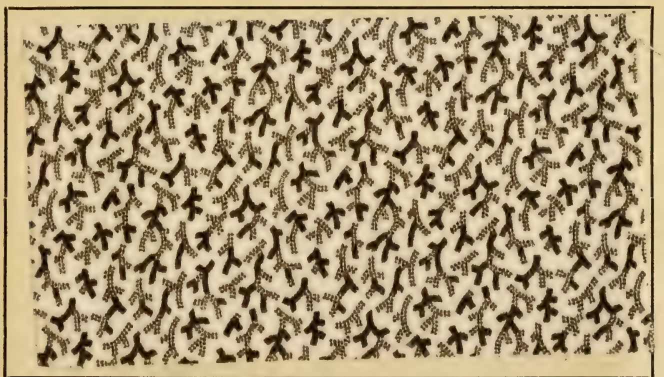
According to the author, this mixture will give 25% weighting to the goods but this we do not guarantee.

67. Printed satin finish not stiffened.

68. Printed satin finish.

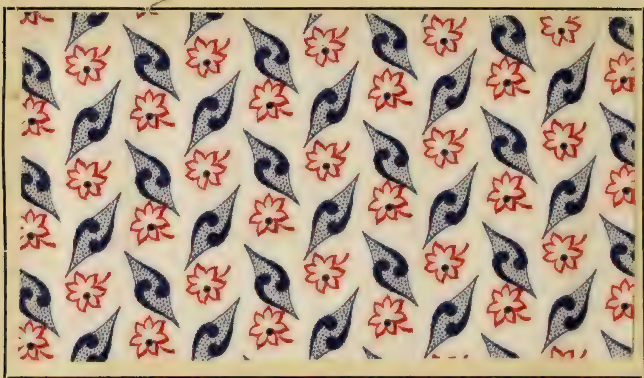


69. Fine cambric not stiffened.

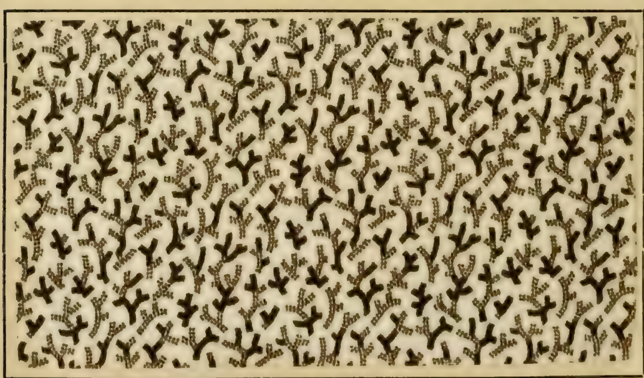


70. Fine cambric stiffened.

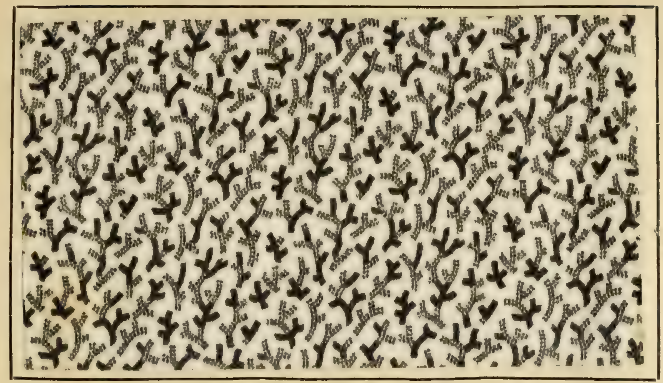
71. Fine cretonne not stiffened.



72. Fine cretonne finished.



73. Prints.



74. Prints leather finish.

67. Ammoniacal apparatine thickening (Puscher).

1 kilo Wheat starch
6 litres Water
Make into a paste and add by degrees
60 gr. Ammonia.

The liquor is of a clear yellow color and thickens considerably and is afterwards diluted with 5 litres water, then boil the whole and stir constantly. The preparation when ready becomes transparent and loses almost the whole of the ammonia by boiling (Method of using as per formula 65.)

68. Weighted thickening with paper pulp (American method).

Instead of china clay, alabaster etc. Richter of New-York uses paper pulp which he mixes

75. Printed brillianté not blued or stiffened.

76. Printed brillianté blued.

77. Printed brillianté blued and stiffened.

with the ordinary thickenings. The pulp or paste must be chosen according to quality of fabrics to be stiffened.

The method of using is the same as for the other thickenings and the goods may be glazed calendered etc. This kind of thickening is specially suitable for stiffening for bookbinders' cloths.

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69. Weighted cellulose thickening (Hartmann).

Fabrics stiffened by this process are used chiefly for linings, buckram, plasters for medical purposes, dolls' clothes, designing paper etc.

Ordinary white cellulose well washed and refined is mixed with potato starch and boiled in an autoclave boiler, constantly stirring.

Starch on large engraved roller mangle as per diag. fig. 9, pl. II. Pass the still damp starched goods between 2 bowls of hardened cautchouc, which thus presses the mixture into the fabric. Dry in the Hot-flue apparatus, then calender dull, glazed or embossed finish as required.

78. Printed chocolate ground not stiffened.

79. Printed chocolate ground back starched half weighted.

80. Shirting not stiffened.

81. Shirting. Half weighted stiffening.

70. Weighted thickening for back-starching (covered grounds).

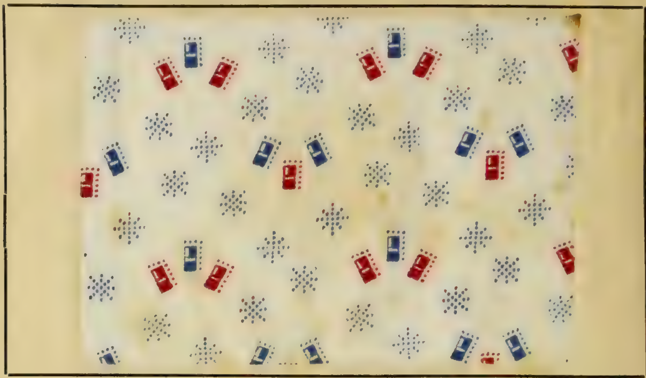
100 litres Water
17 kilos Wheat starch
0·040 gr. Nitric acid
0·250 gr. Turkey red oil
12 litres China clay paste (formula No. 71).

71. China clay paste.

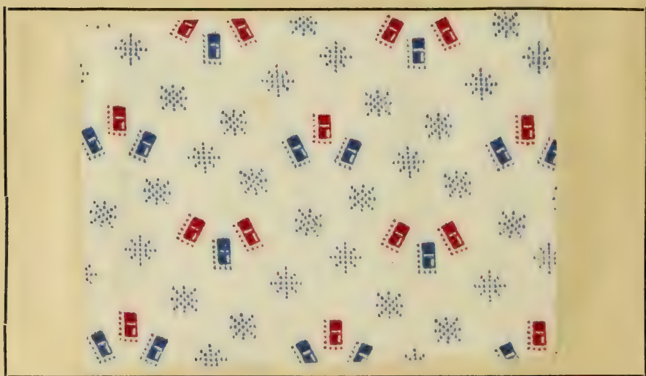
30 kilos China clay 40 litres Water	Well mix and sieve.

Use preparation lukewarm, care being taken to neutralise with the necessary quantity of ammonia, otherwise the excess nitric acid attacks the colours.

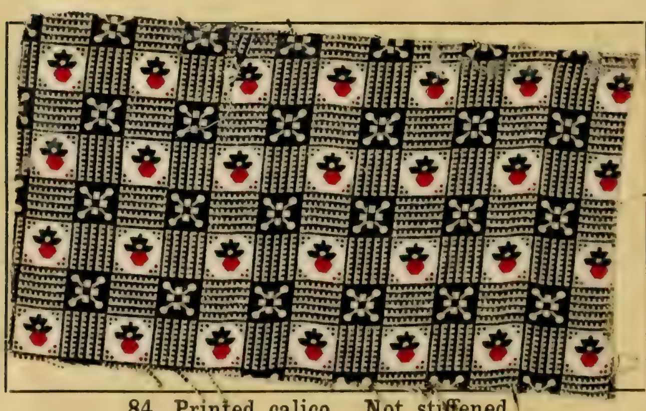
Starch on machine fig. 15, p. 106, dry in cylinder drying machine diagram 11, plate III, after drying batch twice, damping reverse side, calender with lapping and light pressure. See patterns No. 78, 79, 86, 87.



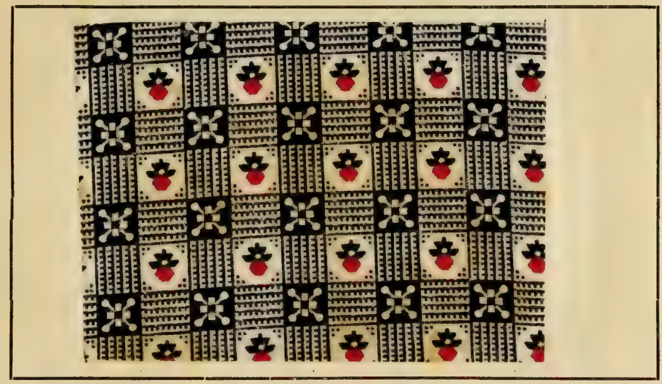
82. Printed white ground. Not stiffened.



83. Printed white ground. Back starched, weighted.



84. Printed calico. Not stiffened.



85. Printed calico. Apparatine stiffening. Half weighted.

72. Thickening for mourning styles (Alsace).

60 litres Water
14 kilos dextrine
0·05 gr. Ammonia
1 kilo Marseilles soap.

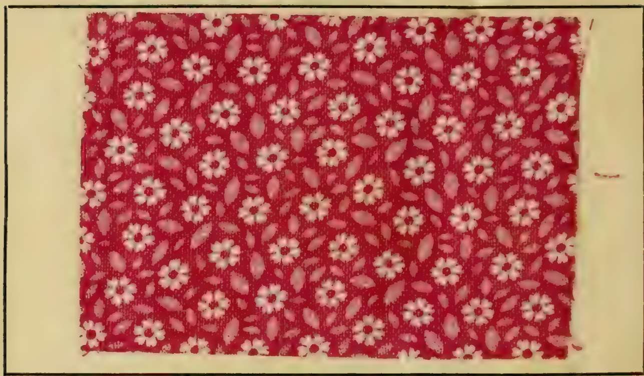
Boil the whole for a few minutes, obtaining 80 litres thickening mixture.

Starch the damped pieces on mangle diagr. 7, pl. II, dry on cylinder drying machine, damp and batch twice.

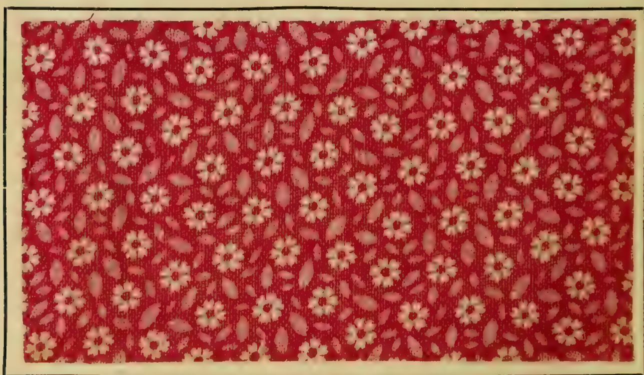
73. Thickening for mourning styles (Stein).

50 kilos White wheat starch
400 gr. Cocoa nut oil
350 litres Water.

Back starch on doctor machine, damp, batch three or four times.



86. Ordinary Prints. Not starched.



87. Ordinary Prints. Back starched.

74. Thickening for cravats. Lawn style.

1500 gr. Rice starch
60 lit. Water well diluted, cold.

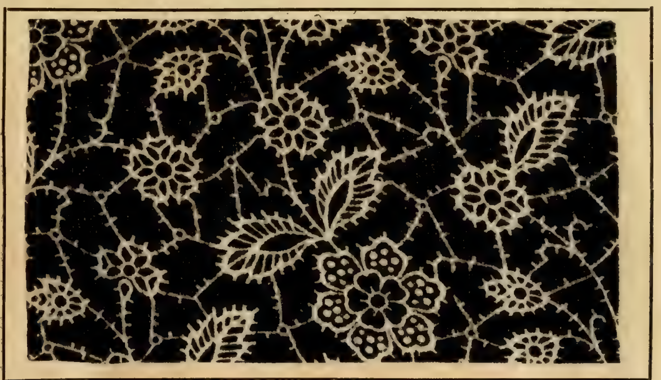
Starch with complete immersion on mangle diag. 4, pl. II, dry on ordinary drying cylinders, damp and calender once only with woollen blanket as in fig. 71, page 221.

75. Thickening for prints. 16 square. (A. Schultz.)

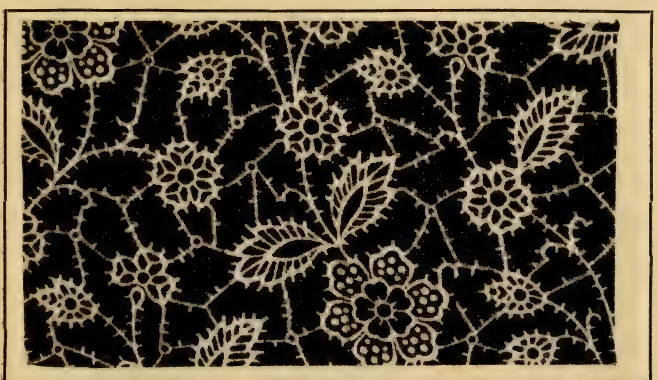
25 – 27 kilos White wheat starch
4 kilos Alabaster
100 litres Water.

Boil direct with a steam-jet until thick, shut off steam, stir up and add:

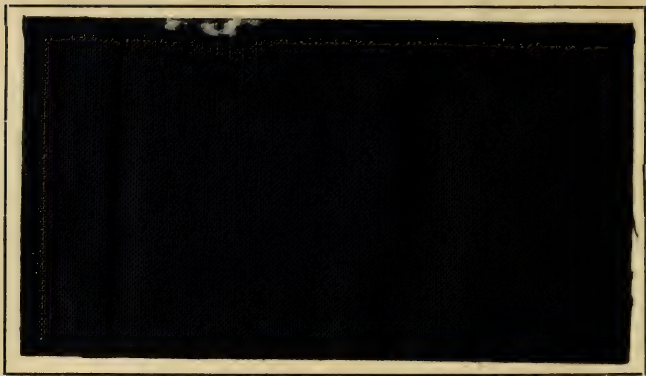
12 litres Marseilles soap solution at
50 gr. per litre.



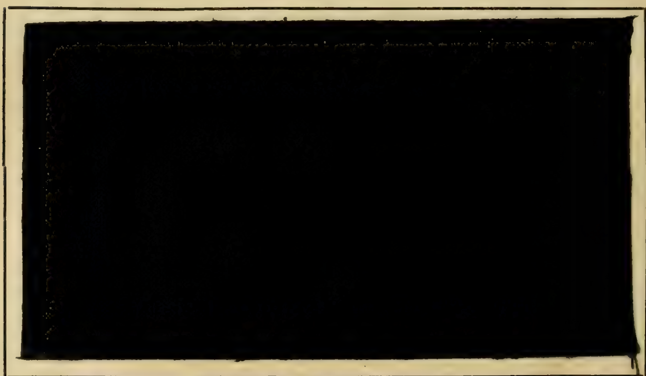
88. Print. Not stiffened.



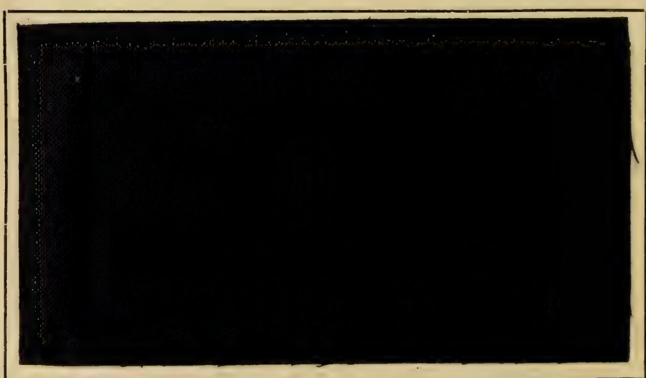
89. Print. Semi mourning finish.



90. Indigo dip. Dull finish.



91. Indigo dip. Chest mangle finish.



92. Indigo dip. Glazed.

First dilute the wheat starch with 40 litres water at 30° C. sieve, then boil the alabaster with 20 litres water, again sieve, mix all together, let the steam enter and stop it as soon as mixture commences to boil. Add stirring well, 20 litres cold water, then the soap solution, afterwards 8 litres cold water. Starch warm on ordinary mangle. This mixture not keeping well it is better to prepare only the necessary quantity.

Damp and calender according to degree of lustre desired.

---

76. Thickening for cambrics (22 threads). (A. Schultz.)

14 kilos	White wheat starch
3—4 kilos	Potato starch
100 litres	Water
400 gr.	Stearine soap Nr. 77.

Boil with live steam and when the mixture has thickened close the valve.

Starch in ordinary mangle complete immersion dry either in cylinder drying machine or stenter. Damp, batch, calender, very lightly or better with endless blanket.

77. Stearine soap.

Melt	5	kilos	Stearine and add
	2	litres	Boiling water
	150	gr.	Soda at 36° B.

Stir until cold.

78. Thickening for dull cretonne finish. 75 portées, 26 thread. (A. Schultz.)

12 kilos Wheat starch
4 kilos Potato starch
90 litres Water.

Boil at low pressure with direct steam; close steam valve when mixture commences to thicken and add

1 kilo Stearine soap Nr. 77.

Starch with doctor, dry on cylindrical stenter, damp and batch without calendering.

79. Thickening for »Popeline« finish. (A. Schultz.)

20 litres Cambric thickening No. 76
100 litres Water
10 litres Tragacanth water at 100 gr. per litre.

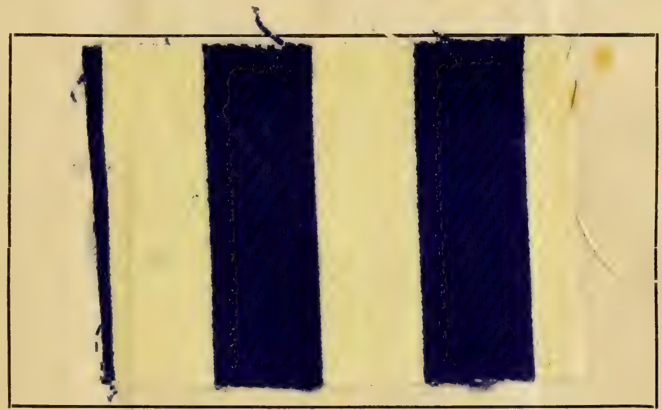
Calender lightly and then starch with doctor.

Dry on fixed stenter taking care to have threads straight and damp.

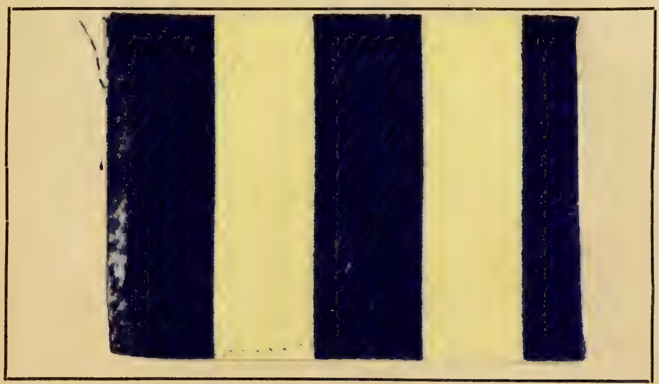
80. Thickening for Lawns.

10	litres	Cambric thickening No. 76
3	litres	Tragacanth gum water at 100 gr. pr. litre
300	gr.	Stearine soap (Nr. 77).

Starch on reverse side on ordinary mangle without doctor, dry on stenter and damp.



93. Heavy (Waste) Twill. Printed not stiffened.



94. Heavy (Waste) Twill. Stiffened.

95. Furniture. Not stiffened.

96. Furniture. Dull finish.

81. Thickening mixture for light fabrics.

100	litres	Water
14	kilos	White wheat starch
4	kilos	Potato starch.

Boil in apparatus fig. 5, p. 75.

82. Thickening for Batist.

20 litres of thickening Nr. 81
6 litres Dextrine at 500 gr. per litre.

Boil in autoclave fig. 5, page 75 for 4 or 5 minutes.

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83. Thickening for »Jaconets«.

60 litres of thickening Nr. 81
10 litres Dextrine water at 500 gr. per litre.

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84. Thickening for »Organtines«.

60 litres of mixture Nr. 81
30 litres Dextrine water at 500 gr. per litre.

These thickenings, receipts 81 to 84, are usually applied with the ordinary mangle diagram 2, plate II, and sometimes with the doctor starch mangle and dried on stenter stretching machines. After drying they are damped lightly and batched several times to break the finish a little. Calender if required with endless blanket or lapping (fig. 71, page 221).

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85. »London« finish. (A. Schultz.)

14 kilos Wheat starch
10 kilos Potato starch
0·8 gr. White wax
220 litres Water.

Boil 10 minutes in autoclave fig. 5, page 75. Add 8 to 10 litres of water; starch afterwards with doctor, dry on stenter, damp then calender on 3 bowl calender fig. 86, page 232 or fig. 90, page 236, first time on reverse side, then twice on right side.

Starch receipts for indigo styles.

86. Stiffening for cretonne.

160 litres Water
35 kilos Dextrine
2 litres Glycerine 28° B.

Dissolve warm and use at 50° C. The preparation must be more or less thickened according to the fabric treated, thus:

at 10° B for $^{19}/_{17}$—$^{19}/_{19}$ Calicoes
at 8° B for $^{20}/_{20}$—$^{20}/_{21}$ Calicoes
at 10° B for coarse fabrics $^{13}/_{13}$
at 7° B for coarse fabrics $^{14}/_{15}$.

Dry on stenter, damp and batch 3 or 4 times or better still, pass lightly through breaking apparatus fig. 61, page 191, see pattern Nr. 90.

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87. Thickening for »Satin« finish.

120 litres Water
2 kilos Marseilles soap
5 kilos White wheat starch boil and add
2 kilos Glycerine 28°.

Dry on cylinder drying machine, damp, calender twice, first time with metal bowl slightly heated 2nd time well heated, both times with right side touching paper bowls. See pattern 92.

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88. Thickening for »Mangle« finish.

200 litres Water
2 kilos Tallow
0.500 gr. Yellow wax
0.300 gr. Stearine
60 kilos White wheat starch.

Boil well and add warm

10 kilos Gum Arabic
0.100 gr. Caustic soda 36°.

Starch warm on friction starch mangle fig. 9, page 98, dry in cylinder machine, damp well double and finish on chest mangle fig. 99, p. 252, 6, 8 and 10 times. See pattern 91.

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89. Thickening for indigo blue, dull finish.

40 litres Water
5 kilos Potato starch (Fecula)
200 gr. White soap.

Boil until dissolved, starch as per diagr. 6, plate II. Dry on clip stenter. Pass through Heilmann's machine, damp and batch.

---

90. Thickening for Dark Green dip styles.

3 kilos White dextrine
60 litres Water.

Starch the damped goods and dry on the cylinder drying machine or on the stenter.

91. Thickening for waste twills (half fustians).

4 to 6 kilos Neutral dextrine
50 litres Water
0.250 gr. Turkey red oil.

Starch as per diagram 2, pl. II, dry on cylinder machine, diagram 12, pl. III, then damp, afterwards passing once or twice through raising machine to bring the nap up again, do not roll up the piece or the nap is flattened. See pattern 93.

92. Thickening for unwashed furniture style.

100 gr. Turkey red oil
1 litre Water.

Starch on right side, diag. 3, pl. II, with a pin-engraved roller and not using more than 6 lit. per 100 metres.

Dry on cylinder machine fig. 18, page 118 B, damp and batch.

Thickenings for ordinary furnitures, cretonnes.

93. Standard or stock mixture.

25 to 27 litres White dextrine
120 litres Water
10 litres Freppel's softening.

	Soaped styles	Unsoaped st. white ground	Dark ground
	94	95	96
Stock mixture	26	26	26
Water	12	14	34

Starch on ordinary mangle as per diagrams 2 or 4, plate II, dry on cylinder machine diag. 10 or 11, pl. III, damp and batch twice.

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97. Thickening for glazed furnitures, chintzes, glazed goods and linings.

Boil in apparatus fig. 5, p. 75
16 kilos Good quality white wheat starch
or
8 kilos Wheat starch
8 kilos Potato starch (Fecula)
Boil 10 minutes direct steam at 3 atmospheres pressure and add:
100 gr. Ultramarine.
250 gr. Wax.

Stir well. Use the preparation lukewarm starch on mangle fig. 8, page 96 or fig. 11, p. 101, dry on cylinder machine with reverse side in contact with tins to prevent the starch scaling off by direct contact.

Batch, damp well and calender twice in friction calender.

Observations on white and plain dyed styles.

As we have already observed (see pages 6 and 7) the slightest alteration in method of procedure gives quite another kind of finish. The varied collection of patterns corroborates this: most of them are either starched with the same thickening and then differently treated and finished or they are starched with the same mixtures in a weaker or stronger state and finished in same manner.

It is universally admitted that of the various textures of cloth each requires special treatment according to its quality reed and pick etc. for instance the following series:

No. 2, 10, 16, 22, 26, 28.
No. 4, 12, 18, 58.
No. 30, 32, 34, 40, 50, 66.
No. 36, 38, 56, 60, 64.
No. 42, 44, 46, 48.

are respectively treated with the same thickenings either alone or mixed with mineral colouring substance, or the method of drying has been varied or again the goods have been finished twice over.

APPENDIX.

98. Finishing for Laundry purposes (shirts collars etc.)

The formula we now give has been largely used by a shirt and collar manufacturer who has kindly allowed us to publish it. This method can be used for small as well as large quantities and it is for this reason we now produce it.

No. 1	40 litres	Water	Boil all well together
	0.060 gr.	Stearine	
	0.100 gr.	Good tallow	
	0.030 gr.	Spermaceti	
	0.030 gr.	Gelatine	

and add

No. 2	1500 gr.	Water in which has been dissolved
	150 gr.	White starch

to this 2nd solution is added, just as it is mixed with the first

No. 3	300 gr.	White starch
	3000 gr.	Water.

Starch and saturate the goods by hand or through a mangle with this mixture then dry, then iron the articles on a table covered with a blanket taking care to cover the articles with

calico. Then to give a high finish damp lightly with a sponge and finish direct with smoothing iron. In this way a finish is obtained remarkable for »feel« and gloss.

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99. Preparation for making cloths incombustible. (Patern's method.)

4 parts Borax.
3 parts Sulphate of magnesia.

Take 1 part by weight of this mixture and dissolve in 4 parts lukewarm water. Borate of magnesia is formed by the heat.

---

100. Preparation for making cloth incombustible (Martin.)

awarded prize by the Société pour encourager l'industrie nationale.

8	kilos	Sulphate of ammonia
$2^1/_2$	„	Carbonate of ammonia
3	„	Boric acid
2	„	Borax
2	„	Wheat starch or 4 kilos Dextrine
100	litres	Water

completely saturate and dry on cylinder drying machine.

---

101. Composition for making cloth incombustible (Chenevier).

100 gr.	Alum
100 gr.	Sulphate of ammonia
45 gr.	Boric acid
30 gr.	Gelatine
9 gr.	Starch (Should probably be 190 gr.?)
1.500 gr.	Water.

It is as well to re-impregnate the material with the mixture from time to time, especially where it is liable to be rubbed.

102. Composition for rendering light fabrics incombustible (Chenevier).

8.000 gr.	Sulphate of ammonia
2.500 gr.	Carbonate of ammonia
3.000 gr.	Boric acid
2.000 gr.	Borax
2.000 gr.	Wheat starch
100.000 gr.	Water.

The wheat starch may be replaced by dextrine or gelatine.

103. Composition for making strong fabrics (waggon-covers, sails etc.) waterproof and incombustible (Dumas).

Impregnate the goods thoroughly with a solution at 40° C. of gelatine at 7%. Dry in the open air. Pass afterwards through an alum bath at 4% dry in open air, wash and dry.

104. Composition for making materials such as theatre curtains, decorations etc. incombustible and water proof (Giraud).

77	kilos	Linseed oil
1.845	gr.	Acetate of lead
10	kilos	Litharge
0·400	gr.	Umber
0·300	gr.	Vegetable wax.
1.200	gr.	Soap powder
700	gr.	Manilla gum
4.000	gr.	Lamp black.
2.000	gr.	Turpentine oil
1.550	gr.	India rubber varnish.

To render the mixture quite homogeneous it must be boiled for at least 30 hours.

105. English method for making cotton fabrics waterproof.

17	litres	Boiling water
500	gr.	Gelatine
500	gr.	Tallow soap, then add gradually
750	gr.	Alum.

Let the mixture cool to 50° C. pass the goods through it at full width, dry by hot air, afterwards starch in the ordinary way, calender etc.

106. Preparation for making fabrics waterproof (L. Figuier 1878, p. 458)

Mix in a mortar:

350 gr. Potash alum 335 gr. Pyrolignite of lead	Pound until deliquescent and add:
200 gr. Bicarbonate of potash 200 gr. Sulphate of soda	Re-pound until completely mixed afterwards add, still pounding:
120 gr. Calcined magnesia	
5 litres Water.	

Pour the mixture into 50 lit. water, stir altogether until completely dissolved, which takes about 20 minutes; then pour this mixture into a receptacle containing 100 litres of water in which has been previously dissolved

150 gr. Tannin
50 gr. Gelatine
100 gr. Yellow resin
50 litres Rain water.

Brew for 20 minutes.

To render the fabric impermeable, impregnate the goods in this mixture which must be constantly stirred, allow to dry and finish by the usual methods.

107. Waterproof mixture for fabrics for balloons, theatre decorations etc. (Depuy de Lomes).

1 part Gelatine
1 part Glycerine
1 part Tannin.

dissolve warm in 12 parts pyrolignous acid at 12°.

CHAPTER VI.

MILDEW OR MOULD FUNGI GROWTH. (1)

On mildew stains etc. in general. Ferments, organisms in the atmosphere. Fungoid growths on cotton. Means of preventing *Mildew* and removing same.

I. Mildew stains in general.

There are innumerable circumstances in which grey or unbleached, white, dyed or printed cotton fabrics may become stained or »spotty« in spite of the most unceasing vigilance and the greatest care.

Summarily stated, the following are instances where discolourations most frequently occur, viz: Bleaching stains of all kinds, stains from lime, acid, chlorine, alcali, ulmic acids, blood, frost, soap, dyeing materials, ordinary lighting gas, which, as well known, acts upon the salts of lead, and aniline blacks, and in general from all materials, and agents employed during the various operations.

Stains or spots from oil, grease, copper etc. from shafting and machinery.

Stains from the starch or thickening ingredients, also those from the ink used in marking, and from

(1) This work has already partly appeared in the „*Bulletin de la Société Industrielle de Rouen 1884*" p. 27 to 62.

rust occasioned by the packing of goods. Stains through drying in the open air, such as soot, coal, herbs and grasses, bird-dung etc.

Stains arising from dead cotton fibres, which do not take certain colours, and thus cause white spots; also from the water employed in washing, when this contains iron for instance, catechu, alizarine pinks, or light chamois (aniline and tannin colors) styles.

Also those stains occasioned by seeds and flower petals, which being carried by the wind and thrown into the water courses, pass into the machines which crush them, when fabrics are washed, and in this way causing sometimes serious accidents. Stains through negligence and inattention, and finally mildew stains. Here we have to examine these only.

They are nearly always found when goods have been once warehoused, either at the works, or buyer's warehouse. They are also frequently produced during the transit of goods, whatever be the mode of packing. In some instances goods have been found to have become completely spoiled, which had been exported in soldered cases. It is evident that these same stains could be formed under certains conditions during the manufacture and finishing of the goods.

They are distinguished in various ways: when very small, and not exceeding more than 1 to

2 *m/m* diameter, they are called mould spots (french »*piqûres*«); these stains are generally pale, yellow chamois, sometimes black, but, more rarely, brown; when they are larger, in such a way as to make large smears, or even irregular patches, they are called mould stains or stains arising from mildew. (*Moisissures*, *Chancissures*, *Trésalures*.)

When goods are spread out upon the meadows to be bleached, microscopical vegetable and thread-like growths are formed under the influence of the humidity of the atmosphere, and which cause grey or greenish-brown stains. (*Hendrissures.*)

Mildew, as we shall see later on, is only produced when certain elements are combined in certain proportions, (azote, oxygen, carbon, mineral substances) and under special conditions (ferments, spores etc.) heat and dampness.

In fact, mildew is the designation for the mouldy appearance and alteration of a fabric produced by minute or microscopical fungi; when we say »*alteration*«, we do not mean that the fabric may have become weakened.

Mildew has three very distinct phases: the first (at the beginning) is that in which the vegetable fungi, yet in a rudimentary state, may be removed by energetic washing or chloring without altering the fabric; in the second stage the fungus growths cannot be removed; in spite af all that may be done, the stain remains, but the fabric is not weakened; and the third stage, where the

growths have acted upon the fabric, this then becomes weakened, and even burnt, the fabric being irretrievably spoiled.

These kinds of stains have quite a special character; reminding one of the mould stains outside casks containing extracts of gum or dye-woods, upon old thickening or sizing materials, or cheese or bread crusts, or slices of lemon; they take all shapes, but most frequently are of circular form, in the style of grease spots formed on broths or soups when cooled. When these stains penetrate several folds of a piece, they decrease or increase from one fold to another; they then assume all colours, but especially white, black, brown, then grey, orange, red and green. Care must be taken not to confound the real with the accidental colour of a mould growth. These growths very often absorb the dyestuff from which they emanate, and become themselves colored, afterwards they throw off or decompose the colouring substance, and take their normal colour alone. Up to the present, blue or violet tinted mould stains do not appear to have presented themselves. Mould stains are formed slightly everywhere, but it will be remarked that they are not often found on the selvages; they are more frequently found in grey and finished white goods than in dyed or printed fabrics. They are often found on certain kinds of black dyed linings finished with fatty thickening substances in spite of suitable warehouseing.

Grey cloth is not more susceptible than dyed or printed, but we shall now see why the former is the most frequently attacked.

In the first place the system of warehouseing is not the same. The places in which printed goods are stocked are more airy, dryer, and in general better kept. Another reason is the frequent changing about of printed fabrics, the consequence of which is an unintentional airing doubtless, but which nevertheless bears its fruit, and finally, as printed goods are more fashionable articles, they are not so long in stock as grey or unbleached fabrics.

II. Ferments and microscopical growths.

Let us suppose that in a given space there exists a spore of mucidness. This spore is arrested on the surface of a liquid placed to receive it, and containing azote (nitrogen), carbon, oxygen, mineral substances, and other necessary elements for its germination, in certain proportions; the germination begins. The vegetable matter throws out its mycelium and its organs of fructification by means of the elements which it finds in the liquor. The oxygen contained in the atmosphere suffices for its combustion, and to sustain the heat necessary for its successive transformation; should the oxygen of the air be exhausted the vegetable growth borrows it from the oxygenous elements in the

liquid. But at the same time new elements are formed in the liquid, some acid, others alkaline, determining, according to their preponderance, the acidity or alkalinity of the liquid, and promoting or impeding the phenomena, as these are of an acid or alkaline nature, in one or the other case according to whether they are or are not neutralized. These changes are more or less slow and give rise to the progressive formation of a series of subordinate principles or elements. When change takes place rapidly, they extinguish themselves by the exhaustion of the nourishing matter, and the formation of definite elementary bodies such as water and carbonic acid.

The liberation of this last is most often noticeable at the commencement, and produces that effervescence which characterises fermentations in ordinary cases. And at the same time that this vegetable ferment thus transforms the middle by the sole fact of the assimilation of the materials it requires, it eliminates, besides, in a more or less directly appreciable manner, the actual residue of digestion, (if they are not secreting products) which can in their turn act upon the liquid in the same way as soluble inorganic ferments or *diastases*. »*Les progrès de l'hygiene*« par le *Dr. Nicolas* p. 78.

Such is the phenomenon of fermentation reduced to its elements, and as discovered by Mr. Pasteur, and particularly from his labors and experiments in the cultivation of ferments.

But what complications are hidden under an apparently simple exterior!

First, „*the air does not secrete all the germs* „*capable of giving birth to phenomena of fermentation,* „*or at least these germs are not always in a suf-* „*ficiently highly-developed state.*" This question is still far from being throughly understood.

On the other hand, the experiments of Mr. Raulin have shewn us what the influence was, not only of the presence of such and such an element in the midst of the ferment, but also of the quantity of these elements.

Oxyde of zinc in the proportion of $^1/_{40,000}$ contained in a liquid in which *aspergillus niger* has been sown is sufficient to increase the fermentation ten-fold. And this rudimentary vegetable requires no less than 12 substances for its development in a given midst.

The process of fermentation varies considerably, according to whether the air be renewed or not; notice in fact those two cases according to whether it furnished the vegetable with the necessary oxygen for consumption or where it was restrained it was obliged to borrow this from the liquid. The *penicillum*, the *aspergillus* etc. are developed in mould-stains in the first phase, that is, the organs of fructification predominate, the mycelium remaining attenuated; on the contrary it is the mycelian tubes which multiply in the case where the air was insufficient. Certain growths are

arrested by contact with air, whilst others only thrive in its vicinity.

Such is the theory we are able to give to-day of the fermentation of microscopical growths. It is clear, that we only occupy ourselves here with growths forming on fabrics i. e. mouldy spots and stains *(piqûres et moisissures)* constituting **mildew.**

Let us try now, according to these data, to reproduce these mould-stains, and for this purpose we shall experiment with a substance, which will serve us in two ways.

First let us see whether the facts bear upon the theory propounded, and if so, they will at the same time explain to us why the majority of bodies of classes 1 and 2. Chapter II, page 12, facilitate mildew formation. Let us take, for example. Wheat-flour: we know that it consists of starch, gluten, water, small quantity of sugar, phosphates and other mineral substances.

Now these substances constitute the elements we are seeking, and at the same time, the composition of these bodies is very similar to that of the greater part of substances employed.

If we make a paste by boiling flour with water and allowing it to cool, we shall obtain a starch, the surface of which in cooling will become covered with a kind of skin. If we place this starch in a *cold* and *dry* place, nothing will be produced for several days; if on the contrary we

remove the skin covering the mass and expose it to the air in a *temperate atmosphere*, and in such conditions, that it is neither *too dry nor too moist*, it is well known to practical people that a mouldiness will be formed in a short time. If we now place a cover on the starchy mass so as to prevent evaporation, an aqueous part will be separated which will appear to have become more unified and consistent than before. What do we observe? This liquid has become alkaline, by litmus paper, and it swarms with animalculae called *bacteria*. During this period the sugar is converted into lactic, butyric and succinic acids, and the ammonia found in the liquid is produced by the quantities of albumen always present in wheat-flour. A few days later the development of the bacteria is stopped through the liquid becoming acid, acidity preventing their fructification. If the cover be now removed and the matter be allowed to remain in a fairly dry atmosphere, we shall find on the surface white spots, which are nothing else than a collection of the mycelium proceeding from the germination of atmospherical spores. These mycelia in order to nourish themselves, decompose the nitrogeneous and other substances in the starch mixture. Finally in the last phase around the white stains, a formation of yellow and even brown circles takes place, these consisting of crenic or hypocrenic acid. (*Würtz*, *Dictionnaire de Chimie*, pages 358, 986).

Up to the present we have not been able to discover whence these spores originate, but they are always present in the atmosphere of our works and warehouses. They are then deposited either on the finishing materials, the colouring matters, or on the fabrics. During the process of boiling, some of these bodies certainly escape. Under normal conditions these spores germinate and develope similarly as an ordinary grain sprouts and extends its roots. Little by little aerial shoots are formed which correspond to the branches of a small shrub. As soon as the azotous substances of the paste have been absorbed and destroyed by these fungoid growths, fructification commences and continues as long as there is nutritive matter present.

When thickenings or starch mixtures contain various chemical products and the formation of these microscopical growths is in progress, only some of these are immediately absorbed by the vegetation, whilst the remaining ones continue for a certain time in another form becoming finally decomposed and absorbed. During this time, the whole surface of the paste has passed through the various phases of an uninterrupted development of fungi, often of a greenish tint, or variously stained by other colours with a green base. If we now submerge these thousands of spores produced by the few deposited on the paste by the atmosphere, by stirring the paste thoroughly and

then place the whole under a cover, we shall deprive them of atmospherical oxygen. They will however, increase in size, reproducing themselves in buds like plants. But we have supposed in our hypothesis, a liquid and here we have experimented with a paste. What is the difference?

In a saccharine solution, the spores and their formations have free movement and their development is considerably favored, whilst in paste, movement is only possible in a limited degree, and the mass decomposes slowly. The action is localised, inasmuch as the paste is not in contact with the germs and cannot move about; the mass thus remains intact for a certain time.

After the mixing of the mass with the germs has taken place, the greenish magma becomes after the lapse of a few days a clotted mass and loses its consistence. The air under the cover bears an alcoholic or ethereous odour and the alcohol and ether may be readily recognised. Then carbonic acid is abundantly produced and at the same time other gases and ethers are liberated, causing those peculiar odours noticeable when substances undergo fermentation. Among these products there is valerate of amyle which it is impossible not to notice. ($C^5 HO.^2$ $C^5 H.^{11}$ *Dictionnaire de Chimie. Würtz* Vol. 5 p. 622.)

We have now reproduced by experiment the data of our hypothesis and we find the following 2 propositions.

1st. Where the air furnishes the oxygen, the fungoid growth or mouldiness is produced on the surface or skin of the paste, the organs of fructification predominate.

2nd. The mass being well mixed with the germs, the air and consequently oxygen has no longer any access, the organs of fructification remain attenuated and here the mycelian tubes pullulate.

We have therefore two very distinct means of propagation of fungoid growths by their spores; the first normal, commencing with the spore which developing itself passes through all phases and produces finally complete vegetation favored by the oxygen of the air. This is especially a fungoid growth or *mouldiness*.

In the second case, the spores are placed in an abnormal condition and vegetate; they are not in direct contact with the atmosphere, and the oxygen they need is borrowed from the centre in which they develop. In obtaining nourishment, the spores cause a decomposition of the mixture around them and which, as we have already seen, takes certain defined forms. This is essentially *fermentation*.

Fermentations are of various kinds, and all these different forms are in more or less direct relation with the abnormal growth of fungi, but it can also be proved indisputably that fermentations are necessarily engendered by particular organisms.

„It is a positive fact to day that fermentations

can be and are more energetically engendered by special living organisms."

„Ce qui est un fait aujourd'hui bien avéré „est que les fermentations peuvent être provoquées „et le sont plus énergiquement par des êtres „organisés speciaux.

(Les fermentations, by Schützenberger p. 39.)

The explanation, by experimental proofs, in support of the relationship which must exist between the chemical phenomenon and the physiological functions is not yet forthcoming and for us, here at least, has only a secondary interest. At all events, we know, that in the process of mildew there are only certain vegetations produced, and that these require special conditions of alimentation or pabulum, which is found in the majority of substances used in finishing materials. We may admit that, until contrary proof be adduced, all kinds of spores are present in the air of our factories, our warehouses in general, or wherever we manipulate our cotton, but only those are developed where the alimentation is suitable. It has been thought that vegetables furnishing amylaceous matters would facilitate the growth of fungi, but varied experience proves the contrary, thus the greater part of microscopical vegetations which grow on cereals, as the *Puccinia graminis, the Uredo linearis, the Ustilago segetum,* and the *Tilletia caries,* do not develop on fabrics starched with the flours, or the starches produced from

these cereals. (Sizing and Mildew in cotton goods. *Davis, Dreyfus* and *Holland* 1880, p. 67.)

Professor *Henslow* has made numerous experiments to develop their growth on unbleached and finished cotton fabrics, but invariably without success; whilst he had no difficulty in developing them on the plants themselves.

According to Pasteur's experiments it would appear that the atmosphere does not always contain spores; we know further that: » the germs » of alcoholic ferments are found on the surface » even of fruit, upon the bunches of grapes, which » contain the sugary liquid, whose decomposition » they will promote by squeezing, as soon as they » come in contact with it. « (Les Fermentations par *Schützenberger*, p. 276.)

The spores of the grape are carried away by the air, and float about in it. We know the origin of these. As to others, whence do they come? Their origin is still unknown to us.

From the preceding remarks, we may state that mildew on cotton fabrics, whether finished or not is dependent on two essential conditions: the first, on the variety of spores which may exist in the atmosphere, and the second, on certain conditions which are essential to their growth.

Heat, dampness, and suitable nutritive elements are indispensable.

The spores of fungi, about which we shall speak later on, may be easily cultivated from

these data. The drawings of these various vegetations represent fungi in a complete state of growth. We must make a few observations here, as to how they are found in a more or less advanced state.

When a simple germination of spores takes place, the development is incomplete. A simple lowering of temperature is sufficient to effect this arrest. It is in this form that goods become as it were »spotted«, or apparently »fly-blown« (*piqûres*) and which is most frequently found on finished goods.

If growth or development takes place, the stain becomes deeper, and the vegetations increase at the expense of the amylaceous matter found in a more than sufficient quantity in the *starched* goods; whereas when mildew is produced on an *unbleached* fabric, the reaction takes place differently. Oxygen (whatever be the mode of packing) is always in sufficient quantity, but the amylaceous or starchy matter is insufficient, owing to the fabric being generally less starched than the other kinds. The cotton fibre is then attacked; it is thus that unbleached fabrics are mildewed or attacked more energetically, i. e. the stains are deeper, than in printed fabrics, and these, on the contrary, are »spotty,« only.

From these differences already pointed out, it is clear that, so long as the fibre is not attacked, and that the fabric is white, these first appearances

of mildew-spots may be removed by washing, soaping, and chloring, but once the fabric has been attacked, all operations are futile, and can only hasten the destruction of the material.

When the fibre has been much mildewed, the cellulose may be decomposed in humic acid, ulmic acid, and other acids of an organic nature.

We have specified two kinds of mildew, viz: »spottiness« (piqûres) as we have termed it, and mildew proper, but a relative value only must be attached to these definitions, which seem to indicate two distinct forms; »spottiness« indicating the first stage of mould formation, and mildew proper the final one. The manner of formation is evidently the same in both cases, except that in the one, the development has been arrested, whilst in the other the propagation is continuous.

III. Atmospherical organisms.

According to recent experiments of Mr. *Miquel*, chief of the Micrographical Section at the Observatory of Montsouris, living organisms in the atmosphere originate from human beings and animals, and the more dense the population, the greater the quantity of microbes in the air; below we give a résumé of the observations of this savant. They show how easily a spore may be found in the air of our workshops, etc. and what part we must assign to so-called antiseptics.

According to Mr. *Miquel* living germs in the atmosphere may be divided into two distinct classes of very different importance and properties; the spores of cryptogamia and bacteria.

I. The spores of cryptogamia are the atmospherical fructifications of vegetations which are for the most part of very small dimensions; at certain seasons the air may contain from 1000 to 2000 per cubic metre: at others it may contain from 100.000 to 200.000, say 200 in a volume of one litre.

Heat and humidity favor the multiplication of spores, and if fine rain or a heavy shower clears the atmosphere temporarily of their presence, it is only for a very brief period.

The plantule requires moisture for its sustenance; with heat, it pullulates, and fructifies rapidly,

and its germs, all aërial, fall and are gathered by the least wind, which carries them afar.

A human being inhales about *300.000* daily, without experiencing any appreciable inconvenience, under ordinary conditions.

Their industrial and economical function is on the other hand considerable, and we believe that in these spores are found chiefly all the spores of mould-fungi in general, and of mildew in particular.

II. The bacteria are infinitely smaller than the spores of cryptogamia; their eggs, when such exist, form bright points distinguishable by their brilliancy under the microscope, but which the most powerful instruments have been hitherto unable to either count or classify. Mr. Miquel separates them into four principal groups: *micrococci*, *bacteria*, *bacilli*, and *vibriones and spirilli.*

Micrococci are usually globular cells without spontaneous movement, they vary in diameter from 0·0005 mm. to 0.0003 mm. According to their age they either have the appearance of cells filled with a slightly refractory protoplasma, or of bright granulations surrounded by a deeply marked black circle.

Bacteria have the appearance of short sticks, movable, isolated or joined together in twos, threes, and fours, but rarely more. They are usually longer than broad, some are globular, and some again are larger at the extremities than in the middle.

Bacilli are formed of cells disposed in rigid filaments of undetermined lengths, moving or motionless, and varying in size from 0·002 mm. to 0·005 mm. in diameter.

Common bacilli possess two means of reproduction: by splitting (scission) and by brilliant grains or spores. If the oxygen of the air has free access, the germinating liquid is regularly disturbed by the bacilli which are very active and relatively short; scissiparite takes place unrestrainedly. If the oxygen reaches the surface with difficulty, this is quickly saturated with carbonic acid; the bacilli come to the top to respire; there, they continue growing excessively without moving about, and form an impenetrable network, which splits up into sections, and resolve themselves into brilliant spores.

Vibriones and *spirilli* placed in the same group by Mr. Miquel, ought really, according to Mr. Marié Davy, to form two classes, if they were more frequently met with in the air.

Vibriones are soft filamentous organisms, developing in the »Culture«-liquid like eels. Air, rain-water, vapor from condensed water rarely contain the germs.

Spirilli are formed of non-extensile filaments of screw-like form, either very long and undulating like vibriones, or very short and rigid, looking like a coiled spring, with short coils, or close and numerous. Spirilli are often found in anatomical

macerations, infusions of decaying vegetables, but very rarely in the dust of air. The number of bacteria found in a litre of rain-water is 16,000 on an average, divided as follows in per cent:

	Micrococci	Bacilli	Bacteria	Total
Rain-water	28	63	9	100
Air of Montsouris park	73	19	8	100

that is, that a litre of rain-water contains:

4,880 micrococci
10,080 bacilli
1,440 bacteria.

The total number of bacteria in a litre o rain-water is found extended on an average in about 200 cubic metres of the air in the park.

This number changes according to the season, being greater in autumn and less in winter.

A *cubic metre* of air, according to these experiments contains:

58 micrococci
15 bacilli
7 bacteria.

The direction of the wind has also a great influence; the air in dwellings is more abundant in bacteria than that of the streets, and all the more so in proportion to bad ventilation. At Paris the number of bacteria increases from the environs towards the centre of the city.

Dry dust shews the same progression, thus: *one gram* of dust contains:

At the Observatory at Montsouris	750,000	bacteria.
Rennes Street (Rue de Rennes)	1,300,000	„
Monge Street (Rue Monge) .	2,100,000	„

The composition of the bacteria changes at the same time. In the Park at Montsouris, the number of microbes falling with dust is 23.000 per square metre in 24 hours.

In the micrographical laboratory this number increases to 2,400,000. It must be therefore much greater in private houses.

From the following table it will be seen how these microbes act when opposed by antiseptic substances, of which we give the minimum quantities sufficient to prevent any fermentation whatever in a litre of neutral meat broth.

Hydrogen peroxide	0·05	gr.
Iodine	0·25	,,
Bromine	0·60	,,
Chloride of zinc	1·90	,,
Phenic acid	3·20	,,
Permanganate of potash . .	3·50	,,
Boric acid	7·50	,,
Salycilate of soda	10·00	,,
Borax	70·00	,,
Anhydrous alcohol	95·00	,,

We are indebted to *Jalau de la Croix* for further researches about the action of antiseptics upon microbes generally; he made experiments with a series of similar meat broths, by adding a few drops of the same kind of broth, but which contained the bacteria in a fully developed state; he then determined the quantity (in milligrams) of antiseptic necessary to stop the pullulations of, or to kill, the microbes, and thus render the liquid sterile. (Les microbes par *Troussaert*, page 243.)

In this manner he examined 20 substances reputed antiseptics, or commonly employed as such, and the results of his experiments he embodied in the following table, which shows the order, according to their activity, of those bodies most interesting to us.

Corrosive sublimate . . .	No. 1	
Chlorine	„ 2	
Chloride of lime	„ 3	
Sulphuric acid	„ 4	
Chloride of zinc	„ ?	Between Sulfuric acid and Essence of mustard.
Permanganate of potash .	„ ?	
Bromine	„ ?	
Iodine	„ ?	
Essence of mustard . . .	„ 9	
Thymol	„ 13	
Salycilic acid	„ 14	
Phenic acid	„ 16	
Boric acid	„ 17	
Borax	„ 18	
Alcohol	„ 19	
Essence of Eucalyptus . .	„ 20	

Oxygenated water is not mentioned here as, according to *P. Bert* and *Regnart*, it has not verified the results expected.

A series of new products as antiseptics has been recently discovered, but as to their worth as such, we must await practical proof. We may however mention:

The *Saccharine* of Dr. *Fahlberg & Lift* (D. R.-P. 35-211 of the 16. August 1884 kl. 12, vide Berichte der Deutschen Chem. Ges. Band XIX. Ref. 374 und 471) Anhydro-orthosulfaminbenzoic acid (Benzoic acid sulfinide). $C_6H_4CO\ SO_2AzH$) is distinguished for its great sweetening properties,

thus 1 gram equals 240 grams of beet-root sugar, and at the present price of sugar (80 fcs. per 100 kilos) saccharine, which can already be produced at 60 fcs. per kilo, is equivalent to sugar costing only one third of its present price. According to *Salkowski* (Arch. f. pathol. Anatomie 105.46 bis 62) *Adduco* and H. *Mosso.* (Archivio per le Scienze mediche, 9.407) and others it is harmless. It is sought to employ it to sweeten grape-sugar instead of cane-sugar, which as Dr. P. *Julius* observes in his excellent work »Die künstlichen organischen Farbstoffe« is not well possible, as in that case sugar is an aliment. This substance has most pronounced antiseptic properties ; as no experiments have yet been made it is not possible however to speak of its value as an antiseptic.(1)

Another substance we are now studying with regard to Mildew and which promises to have a great future is Sezolic (or Sozol) acid (Ortho-oxyphenyl-sulfo-acid) first called Aseptol, which is analogous to Salycilic or Phenic acid, being similar to these in molecular structure.

Aseptol is a phenic acid. It is this very *acidity which enables* it to saturate the ammoniacal bases which form part of the ferments of putrefaction.

Sozolic acid (from σωζω to preserve), according to Mr. *Serrant* is superior as an antiseptic to

(1) This material is now introduced to commerce in large quantities.

salicylic and phenic acids. It is used already for the tawing of skins, in the manufacture of glue etc. where it has the double advantage of carrying off the noxious smells, and securing the preservation of the raw materials. It is called in chemical nomenclature orthoxyphenil-sulfonic acid (See Moniteur scientifique du Dr. *Quesneville* 1884-85-86).

It is prepared in the following manner: pure phenic acid is treated in equal proportions with concentrated sulphuric acid, taking care to prevent any increase in the temperature. The excess of sulfuric acid is afterwards saturated with carbonate of baryta; filter and concentrate in vacuum. Care must be especially taken to operate cold, otherwise another modification is obtained, which has by no means the same properties.

We may mention in passing Salol and Iodol, though neither are useful for our purpose.

V. Neucki's Salol (Phenol salicylate) vide Production from Eckenrodst (Arch. Pharm. [3] 24. 928—931) is insoluble in water and has, according to Pinest (Compt. rendu Soc. biolog. 1886, 450—451) but small antiseptic properties; it is inferior in every respect to Salicylic acid.

Iodol (Tetrajod pyroll) is certainly a most active antiseptic (see G. Ciamician, Gaz. chim. XVI. 1886, pages 543—548; Atti d. R. Acc. d. Lincei Rudet, 1886 II, p. 252—256, D. R. P. No. 35, 130 Berichte der Chem. Ges. XIX. p. 327) but it is insoluble in water and too expensive for our purposes.

IV. On microscopical vegetations on cotton.

Microphytes, which are formed on fabrics have been seriously studied and particularly in England, where the question of mildew has occasioned numerous law-suits, among which we will mention one, which attracted a deal of attention.

Some ten years ago an English house shipped 20,000 pieces of calico to India, on arrival the goods were refused as being defective, upon examination they were found to be mildewed, and in consequence unsaleable.

In the following descriptions we quote from the works of Berckely, Cooke, Persoon, Kunze, Link, Brown, Smith etc.

According to these authors there are no less than 30 fungoid growths with separate characteristics found in mildew.

Before specifying them, we give a summary classification of the various microscopical vegetations.

For more detailed information we refer the reader to the following works, in which all the characteristics relating to these plants will be found.

»*Rust, Smut, Mildew and Mould*» Cooke, 1878.

»*Selecta Fungorum Carpologia*« Tulasne, Paris, 1865.

»*Introduction to cryptogamic Botany*» Berckely, 1857.

»*Handbook of British Fungi*« Cooke, 1871.

»*Fungi*» Cooke and Berckely 1875.

An easy method of examining a mould fungus stain is to cut the goods through the centre of the stain, and in the direction of the weft; then carefully withdraw a thread of weft, this leaving sufficient matter for microscopical examination. It is advisable to commence with a low magnifying power. We abstain from giving the method of working with the microscope, as there are several excellent works dealing specially with this subject; for instance the valuable books: *Dr. Beale's,* »How to work with the Microscope,» and »Practical microscopy« by G. E. Davis.

CLASSIFICATION OF MICROSCOPICAL VEGETATIONS.

	Ascomycetes		Aspergillus	dubius	colourless spores.
			Acrospeira		
			Acremonium	glaucus	greenish "
SPORIDIFERAE			Bolacotricha		
			Botrytis	candidus	white "
			Botryasporium		
			Cylindrium	mollis	white "
	Physomycetes	Isariacees	Clonostachys		
			Chaetopsis		
		Stilleacees	Dactylium	virens	greenish "
			Fusidium		
			Gonatabotrys	roseus	pink "
	Hyphomycetes	Dematicees	Gonytrichum		
			Haplaria		
		Mucedinees	Menispora	crustaceum	greenish "
			Nematagonum		
	Conyamycetes	Sepedonicees	Monilia		
			Myxatrichum		
SPORIFERAE			Oïdium	sparsum	white "
			Papulaspora		
	Gasteromycetes		Penicillum	bicolor	glaucous "
			Peronospora		
			Palyactis	candidum	white "
			Rhopalomyces		
			Rhinotrichum	chartarum	greenish "
	Hymenomycetes		Stysanus		
			Verticillium	subtile	white "
			Zygodesmus		
			Virgaria	sitaphilum	yellow "

The following fungoid growths are found on cotton fabrics:

Fig. 136. Mucor mucedo when exposed to air.

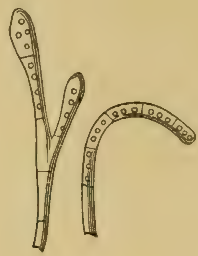

Fig. 137. Mucor mucedo in flour paste, not having contact with air.

— *Mucor mucedo,* Fig. 136, 137 one of the most common, it is also found on stale bread, cheese, and generally on vegetable food-stuffs; it is characteristic and cannot be mistaken for

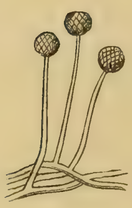

Fig. 138. Periconia glaucocephala.

Fig. 139. Stachybotrys atra.

other mucors, such as those growing on fecal, animal, refuse. It consists of blackish capsules filled with spores, and attached to a colourless pedicle.

The Periconia glaucocephala, fig. 138, the mycelium of which is brownish, and the heads of the spores glaucous as the name indicates.

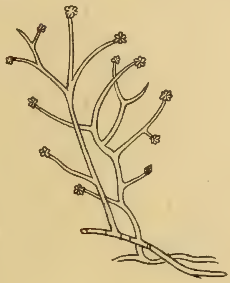

Fig. 140. Stachybotrys lobulata. Fig. 141. Diploïdia Cowdellii.

The Stachybotrys atra, fig. 139, and *the Stachybotrys lobulata* have blackish roots, with yellow shoots and orange stems, and the heads of spores brown.

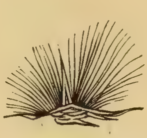

Fig. 142 and 143. Chaetonium chartarum.

The Diploïdia Cowdellii, fig. 141, which is rare on cotton goods forms black stains.

The Chaetonium chartarum, fig. 142 and 143, presents itself as a black spot encircled by a yellowish fringe.

The Perisporium vulgare, fig. 144, with black stems and brown spores.

The Ailographum maculare, fig. 145, produces black spots (or stains).

Fig. 144. Perisporium vulgare with fruit enlarged.

Fig. 145. Ailographum maculare.

These seven varieties constitute the nomenclature of black fungal stains.

The brown or deep green vegetations are:

Fig. 146. Clodosporium herbarum.

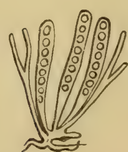

Fig. 147. Orbicula cyclospora.

The Clodosporium herbarum, fig. 146, which is very common and believed to be identical with the Sphoeria herbarum.

The Orbicula cyclospora, fig. 147, dark brown growth with lacteous spores.

The Ascotricha chartarum, fig. 148, with brown mycelium and spores of a chocolate colour.

The Polyactis fascicularis, fig. 149, with a colourless mycelium and brown spores.

Fig. 148. Ascotricha chartarum. Fig. 149. Polyactis fascicularis.

The Rhopalomyces pallidus, fig. 150, fawn coloured.

The Myxotrichum chartarum and *the Myxotrichum deflexum*, fig. 151, form ashy coloured stains.

Fig. 150. Rhopalomyces pallidus. Fig. 151. Myxotrichum deflexum.

The Sporocybe alternata and *Ascophora mucedo*, fig. 151.

The three following give the fabric a pink colouring.

The Aspergillus roseus, fig. 153, with colourless mycelium, and red tinted heads.

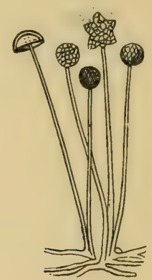

Fig. 152. Ascophora mucedo.

Fig. 153. Aspergillus roseus.

The Papulaspora sapedionioïdes, fig. 154, likewise with colourless mycelium and brick red heads.

Fig. 154. Papulaspora sapedionioïdes.

Fig. 155. Ascobolus saccharinus.

The Ascobolus saccharinus, fig. 155, gives large salmon coloured stains.

The yellow mildew stains are formed by:

The Arcyria ochroleuca, fig. 156, easily recognisable by the special structure of its mycelium.

The Penicillum sitophillum, fig. 157, which is believed to be analogous to the *Oïdium aurantiacum.*

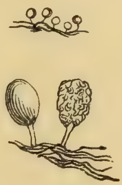

Fig. 156. Arcyria ochroleuca natural size and enlarged.

Fig. 157. Penicillum sitophillum or Oïdium Aurantiacum.

The white fungoid growths are often caused by:

The Acremonium alternatum, fig. 158, which is very common; sometimes but rarely, the *Typhula gyrans*, fig. 159, is found.

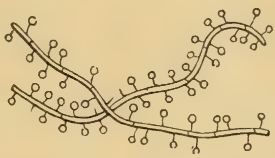

Fig. 158. Acremonium alternatum.

Fig. 159. Typhula gyrans.

The green fungoid vegetations are the most common of all.

The Penicillum glaucum, fig. 160, and *the Penicillum crustaceum.*

The Penicillum chartarum, fig. 162, is also found with its colourless mycelium and greenish spores.

Fig. 160. Penicillum glaucum.

Fig. 161. Aspergillus glaucus.

Finally there is the *Aspergillus glaucus*, fig. 161, which is one of the most common, and the *Aspergillus alternatus*, fig. 163.

Fig. 162. Penicillum chartarum.

Fig. 163. Aspergillus alternatus.

Of the various illustrations just given, some are taken from nature, others from Pouillet, and

others from Davis. The enlargement varies from 40 to 360 times.

The foregoing represent the principal microphytes or fungi growing on cotton goods, and from the figures they may be easily recognised and distinguished.

Moreover they are not likely to be mistaken for other fungoid growths frequently met with, as these have quite a different character and are distinguishable by the naked eye owing to their

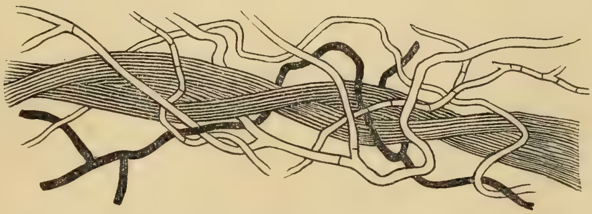

Fig. 164. Cotton fibres with their mycellian filaments.

special forms. Such are the fungi attacking fruit (*Oïdium fructigerum*) those forming in cellars, on barrels (*Rhacodium cellare*) or those on water pipes made of wood and beginning to rot (*Rhizomorpha subterranea*) which form blotches and stains of quite a different aspect to those of mildew on cloth.

According to Dr. *Troussaert* (Les Microbes, les Ferments et les Moisissures, Paris 1886) old and new researches show that the fungi of mildew

present a considerable polymorphism, and such as completely disturbs the classification of these cryptogams.

These researches have been recently undertaken by Mr. *Cocàrdas* (Journal de Micrographie 1884—1885) who believes he can demonstrate that all fungal growths found in sweetened liquids allowed to ferment, and in pharmaceutical extracts, belong to one and the same species, highly polymorphous, and which he calls the *Penicillum-ferment*.

Mr. *Cocàrdas* claims to have seen this *Penicillum-ferment* pass successively through the *corpuscular* (Micrococcus) state, *bacteridian* (Bacterium), *zooglarian* (Zoogloea), *aquatic filamentous* (torula) *fructiferous filamentous* (endogen spores) the whole constituting the algous phase of the cryptogam forming part of the syrup, but swimming on the surface.

Then begins the *fungus phase* as the little heaps of endogenous spores, swimming on the surface of the liquid, germinate and sprout. These buds lengthen, separate, and ramify into aërial mycelium on which the aërial fructifications are developed and which can only be formed and exist out of the liquid, although these aërial fructifications all proceeding from the same mycelium may assume either the *aspergillus* or *mucor* or the *penicillus* shape according to the disposal of the spores on the fructiferous filament.

In other words the characteristics considered until now as specially typical of the three classes Aspergillus, Mucor and Penicillum, which are themselves types of three very distinct genera would seem to be found together, either simultaneously or successively on the same filament of mycelium,

Fig. 165. Penicillum - ferment (according to Cocardas) Aërial fructifications in liquorice extract, the three forms: Mucor (1), Penicillum (2) and Aspergillus (3) are growing on the same mycelian filament A (enlarged 225 times).

and to be nothing but the varied forms of a very polymorphous species, the Penicillum-ferment (*Cocardas*).

Fig. 165, p. 441, taken from »Les Microbes« by Dr. *Troussaert* represents the three principal

forms of mould fungi which the author states having seen under the microscope growing together on the same mycelian filament.

Each of the forms of the Penicillum correspond to a particular alteration of the syrups or solutions.

In thick (nourishing) syrups the ferment is in a bacteridian state, in liquid or flowing solutions the ferment is in a zooglarian or simple filamentous state; in sour solutions the ferment is in a state of aquatic fructification, and finally in mouldy solutions it is in a state of aërial fructification.

Such is the really surprising polymorphism which Mr. *Cocardas* says he has observed, taking all ordinary precautions to guard against serious errors.

In spite of similar facts previously advanced, notably by *Hallier*, but too often contradicted by more searching investigations, it may fairly be allowed to ask whether this is not simply a phenomenon of modification analogous to that which rightly or wrongly has been supposed to exist with lichens.

Further and more precise researches with sterilised liquids and taking more special precautions will be necessary before these statements can be considered as definitely and scientifically demonstrated.

The artificial reproduction of mildew has often been essayed. The most interesting and at the

same time the most conclusive experiments are those of *Davis*, *Dreyfus* and *Holland* (Sizing and Mildew in Cotton goods, pages 205 and following) which we cannot reproduce in full, but of which we shall give a summary.

Let us review first the composition of the fibre:

1st As regards the quantity of water absorbed.
2nd As regards the quantity of size or finishing mixture.
3rd As regards salts and their influence, and then the action of the various substances of classes 1, 2, 3, page 12.

As regards the component parts the following is according to *Thomson* (The Sizing of Cotton Goods 2nd Edition, 1879, page 226) an average of analyses shewing the actual quantities of fibre, water, amylaceous matter, salts and inert substances. These analyses are made on grey cloths with the warps sized in the dressing.

We shall observe first of all in these analyses that there are cloths which contain nearly 50% of foreign matter. These are, it may be mentioned, English cloths, and it is well known to what extent »weighting« has been carried in that country; this is seldom the case with cloths of French manufacture, it is only for white finish that sometimes a little weight is added, but very

rarely in such large proportions as customary in England. As a rule French printers cloths lose from 20 to 25% of their weight in bleaching to obtain a white for printing.

In greys bleached for sale as white goods the loss is from 12% to 18%.

Experiments with regard to mildew made with these various qualities of cloths have shown that contrary to what was expected, chloride of magnesium and chloride of zinc, instead of preventing mildew actually favour it. (*Davis Dreyfus*, loco citato page 223.) See table page 445.

Raw cotton contains in itself in sufficient quantity the elements necessary for the growth of vegetations: thus in comparing its composition with Pasteur's and Raulin's liquors (1), so appropriate to the formation of mildew, the following figures are found. (*Davis Dreyfus* p. 198.) See table p. 446.

(1) Raulin's liquor (Les Fermentations par *Schützenberger*, page 82)

Water	1500·00
Candied Sugar	70·00
Tartaric Acid	4 00
Nitrate of Ammonia	0·40
Phosphate of Ammonia	0·60
Carbonate of Potash	0·60
,, of Magnesia	0·40
Sulphate of Ammonia	0·25
,, ,, Zinc	0·07
,, ,, Iron	0·07
Silicate of Potash	0·07

Analyses of 6 different samples of grey cloth.

	PERCENTAGE.					
	1	2	3	4	5	6
CLOTH.						
Fibre	47·29	53·02	60·75	70·84	80·51	81·78
Natural moisture	4·11	4·61	5·28	6·16	7·02	7·11
SIZING.						
Moisture in size	6·01	5·02	4·65	3·07	2·01	2·89
Starch and fatty matters .	12·77	13.36	13·33	12·43	8·30	3·33
Mineral matter	29·82	23·99	15·99	7·50	2·16	4·89
	100·00	100·00	100·00	100·00	100·00	100.00
Weight per cent of cloth .	51·40	57·63	66·03	77·00	87·53	88.89
do. do. of finish	48·60	42·37	33·97	23·00	12·47	11·11
Thomson admits the normal quantity of water at 8% these various cases would therefore show an excess of water of	2.12	1.63	1·93	1·23	1·03	2·00
The mineral matter is composed of:						
China Clay	much	1·08	11.45	chiefly	chiefly	chiefly
Chloride of Magnesium .	little	2·42	trace	—	—	—
do. Calcium . .	—	0·43	2·50	—	—	—
do. Zinc	little	6·06	2·04	little	—	—
do. Sodium . . .	trace	trace	trace	trace	—	—

PARTS IN 10.000			
ELEMENTS	RAW COTTON	SOLUTIONS of PASTEUR	SOLUTIONS of RAULIN
Phosphates reckoned as Phosphates of Calcium	10·47	20·00	4·80
Potassium reckoned as Carbonate	52·62	16 00	4·44
Azote (proceeding from vegetable Albumen)	3·45	8·33	10·50

From the preceding table it is seen that all the elements are largely represented.

We must add, in treating finished goods, to the preceding elements the component parts of the starches , such are the substances of class 1 i. e. Starches proper, feculas of cereals, gums, glutens, sago, rice, tapioca etc. (See page 12).

The substances of class II are equally favorable through their chemical composition, fats and oils. Glucose is recognised as being one of the best fermentescible matters.

We have likewise mentioned the influence of chloride of calcium and of chloride of zinc.

In the following table we shall see how much time is approximately requisite to develop mildew on the substances of class I. The experiments

are made on pastes consisting of 10% of the substance itself and 90% of water.

The starches it is almost needless to say have been put in the ordinary conditions, as regards temperature and the circulating air. By increasing the heat and the moisture, the vegetations may of course be produced far more quickly. It is possible to obtain even strong vegetations (or growths) in 40 hours. (See *Thomson*, The Sizing of Cotton goods.)

Flour from wheat becomes mouldy at the end of				6	days
do. do. (Egyptian)		do.		6	»
do. do. containing 1% of alcohol				6	»
do. do. do. 2½% do.				6	»
do. do. which has fermented becomes mouldy at the end of				7	»
do. of rice		»	»	8	»
Starch from wheat becomes mouldy		»	»	11	»
do. do. rice	»	»	»	17	»
Ordinary flour	»	»	»	11	»
Tapioca	»	»	»	10	»
Sago	»	»	»	10	»
Starch from maize	»	»	»	10	»
White dextrine	»	»	»	16	»
Dextrine (British gum) calcined light		»	»	16	»
do. do. do. dark		»	»	16	»

A sudden falling of the temperature after it has been fairly high is always favorable to the

formation of mould because the capacity of air to absorb moisture increases with the temperature; when this latter falls it provokes a condensation which carries down with it the spores that may be in the air; on the other hand, the higher the temperature the more moisture contained in the air and thereby mouldiness is favored; this is why mildew is always more common in warm than in cold climates, in moist than in dry places.

The quantity of water absorbed by the fabric may reach 20%, that is if there be no hygrometrical substances in the size; in which case the percentage may be considerably increased.

Grey cloth absorbs moisture more readily than unfinished bleached cloth; it has been observed, and the fact is known to all printers, that white cloths not stiffened are the least liable to become mildewed. This observation leads one to believe that grey cloth contains spores which bleaching destroys. At any rate the azoteous (vegetable albumen) substances disappearing in the bleaching process, there is thus already one element of mould the less. As soon as the bleached cloth again undergoes the finishing manipulations, all the conditions favorable to mould fungi are united, and mildew may be developed.

We conclude this chapter with a summary of various experiments on the mildewing of cotton goods, variously finished (according to *Davis*, *Dreyfus* and *Holland* page 205).

Cloths were experimented upon containing size only, othêrs with admixture of china clay, fatty matters, deliquescent salts, chlorides of magnesium, of zinc and of calcium.

These various specimens were exposed in atmospheres with a temperature from 25° C. to 30° C. with 1 to 2 even 2½° C. less at the wet bulb of the psychrometer

As a result *all* the cloths were covered with mildew. The more chloride of magnesium there was the more mildewed were the cloths, one sample containing 2% of it showed scarcely any mildew whereas those with 30% were covered with it.

Ordinary cloths sprinkled with Raulin's liquor, and then exposed to a temperature of 21° C. to 19° C. showed mildew spots already after 40 hours.

In short we may conclude with all the authors who have treated this subject, that *all finished cotton goods whatever the finish, are liable to become mildewed.* This conclusion is correct granted that the finishing has been done with the usual materials; but according to our personal experience the finish with »apparatine« delays almost indefinitely the formation of fungi.

The finishes with antiseptics also become mildewed, but they resist for a certain length of time and also require special circumstances to

produce it. It is necessary therefore to use antiseptics in such proportions as retard fungoid growths, although circumstances favorable for its formation be present.

5. On the means of preventing and removing mould, fungoid growths, mildew etc.

We have seen how mildew is formed. Let us now examine what are the means of preventing it.

Raw cotton, with the small quantities of starch indispensable for spinning and weaving, is in itself a very favorable ground for the propagation of microscopic growths.

Bleached cloth, not stiffened, which is almost pure cellulose, is the form under which the fabric is least subject to mildew, it is also the one least frequently met with in commerce; such cotton goods invariably have to undergo the operations of dyeing, printing or finishing, however slight these may be.

These operations furnish the missing elements, for whenever these are present, heat and moisture being favorable, mildew will appear on a cloth containing spores, a contingency, which we have seen is not at all unlikely.

It is therefore of the greatest importance to see that no cloths whatsoever be exposed in moist places, or to a temperature exceeding 20° C.

We know a case in point where an important Russian manufacturer, experienced heavy losses through neglecting these precautions. The finishing department was situated in a marshy locality; moreover the processes of manufacture necessitated a certain temperature. The finished pieces appeared quite intact, but after remaining a few weeks in the warehouses at Moscow, mildew began to form, especially at the selvages. It was sought to remedy this by the incorporation of antiseptics with the starch mixtures; damping was also done with water charged with antiseptical substances; but all to no purpose.

Acting on our advice the finishing establishment was removed to a higher and drier neighbourhood and from that moment all annoyances ceased and no similar accident has occurred since.

What are the means that might be applied? We have described at length the various antiseptics, which may be employed, but we are bound to say that up to the present none of these substances have given *absolutely* satisfactory results. There is therefore an open field for practical men, and we trust that, with the help of chemistry, which places so many new substances att heir disposal, this gap will ere long be filled up.

Besides antiseptics other means have been proposed. (See pages 51 and following.)

It is perfectly well known that cold is an excellent agent for preventing the development of these growths or to stop those that have begun, but this remedy is hardly practicable.

Dessication, which likewise would give good results, is not to be attempted.

Another means which we think might give good results, when feasible, is keeping the goods hermetically closed; of course, this cannot be done in the warehouses or at the works, but there the temperature and moisture may easily be regulated. But for sending goods in soldered cases, as is being done for shipments to remote contries we think that this means, which is very simple and now easily practicable, would render good service. It would only be necessary to exhaust the air out of the cases with the pneumatic machine, and then solder them up. Carbonic acid being now produced in a solid state very cheaply might be employed in packing, by introducing a certain quantity in the case after expelling the air, then soldering up again.

Another good method, until now in fact considered as the only practical one, consists in keeping the goods dry, but even this is not always practicable, because it is rather the rule for sellers, in order that the goods may retain a good feel and weight, to keep them in a cool place, where

they absorb about 8% of hygrometrical water. This moisture once taken up by the fibre of the fabrics remains there for a long time and notwithstanding that the cloths are warehoused later on in dry places, they are not safe from mildew, unless currents of air be arranged both under and at the back of the piles of goods, and unless the pieces be often changed about by altering the order of piling, i. e. the top of one pile becoming the bottom of another and so forth.

Summing up then, the means of preventing mildew consist first in avoiding the storage of cloth in moist and hot places, but to chose dry and airy places. Further not to use too much hygrometrical salts in finishing and finally in incorporating with the starch thickenings the appropriate antiseptics considering the particular kind of fabric to be finished.

On the means of removing mildew.

We have indicated, page 406, the three principal degrees or phases of development of mildew; in the first, when the cloths are not affected, and the mould-stains are only superficial, and may be removed from the grey, and from white goods by energetic washing, soaping, and weak chloring repeatedly performed. *This is the only case where the cloth can be restored to its good condition.*

In the second phase when mildew is on the point of attacking the fabric there is then almost no longer any possibility of removing the growths, this would necessitate a too frequent repetition of chloring and consequent risk of damaging the fabric.

In the third phase when the cloth is already damaged the piece is irrevocably lost.

In the case of grey or white goods a more energetic treatment may be resorted to, often resulting in saving the goods; but with printed goods, where the colour has been destroyed, it is seldom they can be restored.

CHAPTER VII.

TESTS AND ANALYSES OF VARIOUS FINISHES.

When it is desired to ascertain how a fabric has been finished, we first examine the external or physical properties by a simple inspection; a practical eye can detect whether the fabric has been simply calendered or glazed, or if starched on the reverse side and so forth. By examining the fabric against the light, it is easy to observe whether it has been »filled« or not; a heavily weighted cloth will lose much of its stiffness by rubbing between the fingers, if a lot of dust flies off in tearing the cloth, this indicates a weighted finish; and by the aid of a powerful magnifying glass, we may see whether the »thickening« be superficial or whether it has penetrated into the fabric, and if it contains mineral substances.

These various external characteristics give substantial data as to the way in which the fabric has been treated.

Afterwards care must be taken to note the quantity of water in the fabric, by weighing a piece of certain dimensions, drying it in a stove until there can be no further loss of weight, then re-weighing the dried piece. The difference of weight will give the quantity of water contained

in the piece. Although we cannot make any immediate deduction from this experiment of the quality of the finish it is better to make it, as we know that cellulose by itself is less hygrometric than wheat and other starches. If there be a great difference in the weight, this is a certain indication of the cloth being heavily starched.

To know exactly how much foreign matter a cloth contains, we treat a piece of cloth say 250 centimetres square with distilled water containing malt, let it disaggregate, wash afterwards and weigh. In this first experiment the difference in weight will indicate the quantity of foreign substances deposited on the fabric; but even after this treatment certain insoluble soaps may still remain in the fabric and it is necessary to again boil in weak acid to remove all fatty matters. Weigh again to obtain the actual total loss, and from the difference in weight the percentage of dry finishing substances is determined. In testing printed or dyed goods, we must bear in mind that all colors are more or less attacked by acids.

We now proceed to examine the components; two operations are necessary; first treat with boiling water for a few hours, this removes the feculae, starches, thickenings, gums, soluble salts, alum, sulphates, chlorides etc. and mineral or earthy matters; secondly by filtering, separate the soluble from the insoluble substances. Soluble

substances are detected in the following manner: evaporate part of the liquid, treat a few drops with tincture of iodine, which will reveal starchy substances by turning blue; if no starch be found, again concentrate the whole and add two or three times its volume of alcohol: glue, dextrine and gum are precipitated. Gelatine is detected by a tannin solution which precipitates it.

To distinguish gum from dextrine we use the polariscope. Dextrine is diverted to the right, gum to the left. The mixture of the two can be sufficiently indicated by basic acetate of lead, which when cold precipitates gum but not dextrine; when warm both are precipitated; if no precipitation be obtained, but an organic substance be still shewn by the incineration on the platinum blade, this indicates the presence of mosses, lichens etc.

Sugar is found by Fehling's liquor before and after interversion; add to the tolerably concentrated aqueous liquor, a few cubic centimetres of pure hydrochloric acid ordinary concentration warm in water bath (bain-marie) in an apparatus with reflux refrigerator and treat with copper solution.

If it is desired to examine still more closely the soluble mineral substances, recourse must be had to the usual methods of analytical chemistry for which we refer the reader to the special treatises thereon.

In the residue insoluble in water, we again find the earthy matters, which it is unnecessary to examine closer, as generally the most economical are employed and china clay is one of the only substances which fulfils almost all the conditions and therefore is also the most used; alabaster, gypsum and talc or french chalk, are also found in this residue.

If it is desired to detect resin, take a sample of the cloth, boil it with carbonate of soda, which dissolves the resin the presence of which is shown by the precipitate of sylvic acid obtained from the liquor when treated by an acid. The other fatty matters do not give any precipitate, but an oily fluid which swims on the surface of the liquor. Glycerine is found in the watery solution and can be detected, after the damping of the drying process by the acroleine reaction, which takes place after treating with sulphate of potash.

To ascertain the quantity of fatty matters contained in a certain finish, a second operation is performed by ether, which dissolves all fatty matters. After evaporation the weight of the residue expresses the quantity of fatty matter. An exact analysis of this mixture is not possible practically; we must be satisfied with treating with boiling water and thus ascertain that there are no soluble substances in the water.

In analysing the quality of a certain finish it is almost impossible to obtain the quantitative

proportions: the various qualities of cloth requiring such varied treatment. The principal point is to know what substances are incorporated and this determination once made, it is for the practitioner to discover by preliminary experiments, the proportion of the various ingredients.

INDEX.

Elementary treatise on the finishing of white, dyed and printed cotton goods.

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ERRATA.

Page	Line	INSTEAD OF	READ
1	9.	establishments works	establishments or works
3	5.	furnishes	furnished
7	15.	they are done	are done
13	10.	Carbolic cacid reosote	Carbolic acid creosote
14	25.	Was it forgotten or did it fall into	Whether it were forgotten or fell into
14	26.	demand of	demand for
14	28.	is	are
25	10.	hin	him
26	1.	neuter	neutral
26	20.	degress	degrees
28	36.	that finishers	of finishers
28	37.	into account this fact.	this fact into account
29	14.	dissolution	solution *)
36	2	sizer	sizer or finisher.
43	30.	so	to
45	5.	the industry	trade
45	8.	having	having had
56	11. and 12.	permangates	permanganates.
72	Fig. 3	Movable	portable
78	Fig. 6	Colour Straynings Machine	Colour Straining Machine
83	11.	or starch	starch or
95	2.	ruil contrivance	rail or contrivance
95	5.	If, the piece is wanled	If the piece is wanted.
98	Fig. 9	Sizing machine	3 Bowl Starch mangle
109	15.	unsteady	irregular
109	24.	weather in	in weather.
110	22—23.	saturated	saturated with
111	10.	impustation	impastation
112	5.	sweft	weft
112	6.	which drying rooms generally	drying rooms which generally
113	21.	which passing	passing
117	7.	These	This
133 134	24. 12.	woods	hoods

*) Read afterwards „solution“ for „dissolution“.

Page	Line	INSTEAD OF	READ
134	29.	result in	result is
138	14.	shaking	Jig or vibrating
145	24.	are rolled	can be rolled
193	10.		Fig. 61.
196	17.	soaping	washing
262	20.	folding	doubling
269	29.	Cross-over	Diagonal
306	14.	stainers	stainers and calico Printers
308	2.		vide plate IX.
317	24.	moirée	Moreen
348	Receipt 32	Tig	Jig.

NB. Readers will please overlook other insignificant compositors' errors, such as dropping of type, faulty punctuation, etc., the work having had to be printed abroad.

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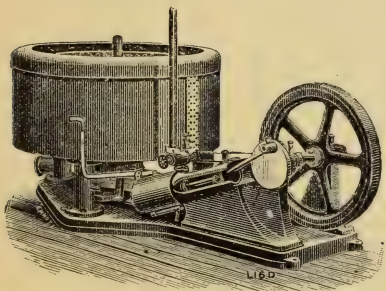

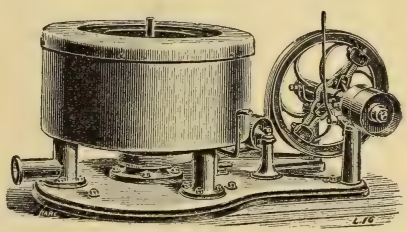

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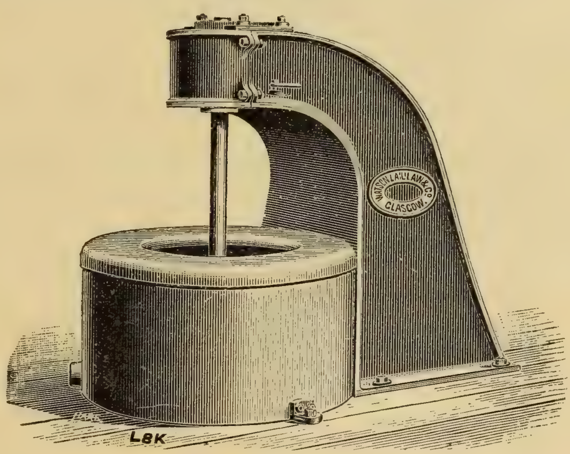

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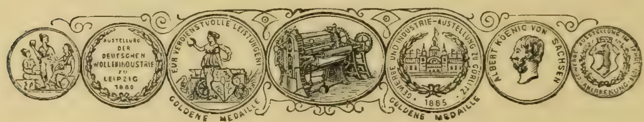

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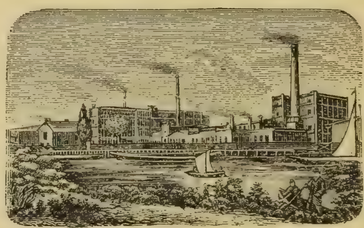

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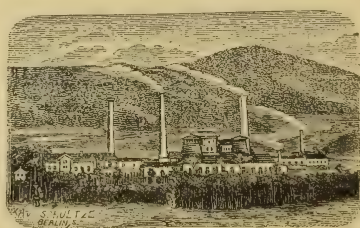

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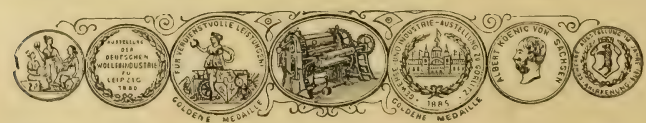

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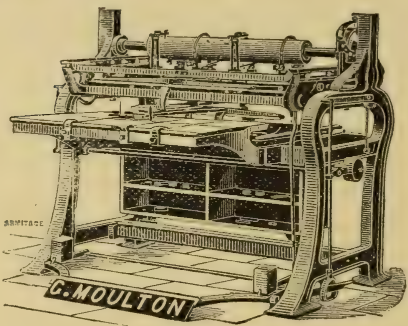

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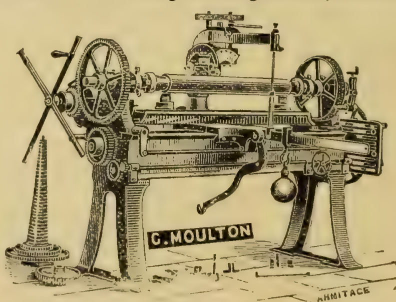

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